GRADUATE COLLEGE CATALOG | UNIVERSITY OF ILLINOIS AT CHICAGO CIRCLE | 1969-1970
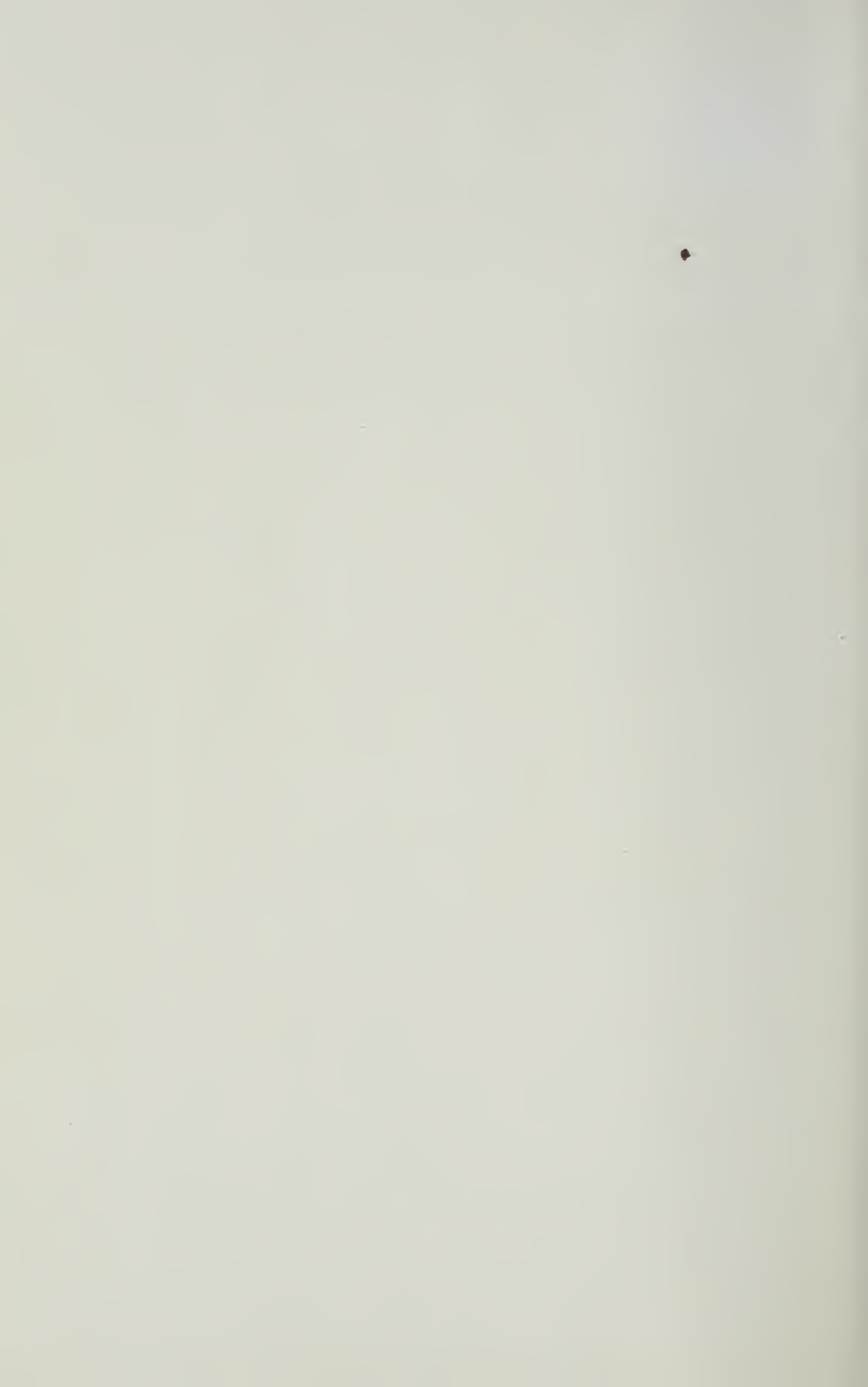
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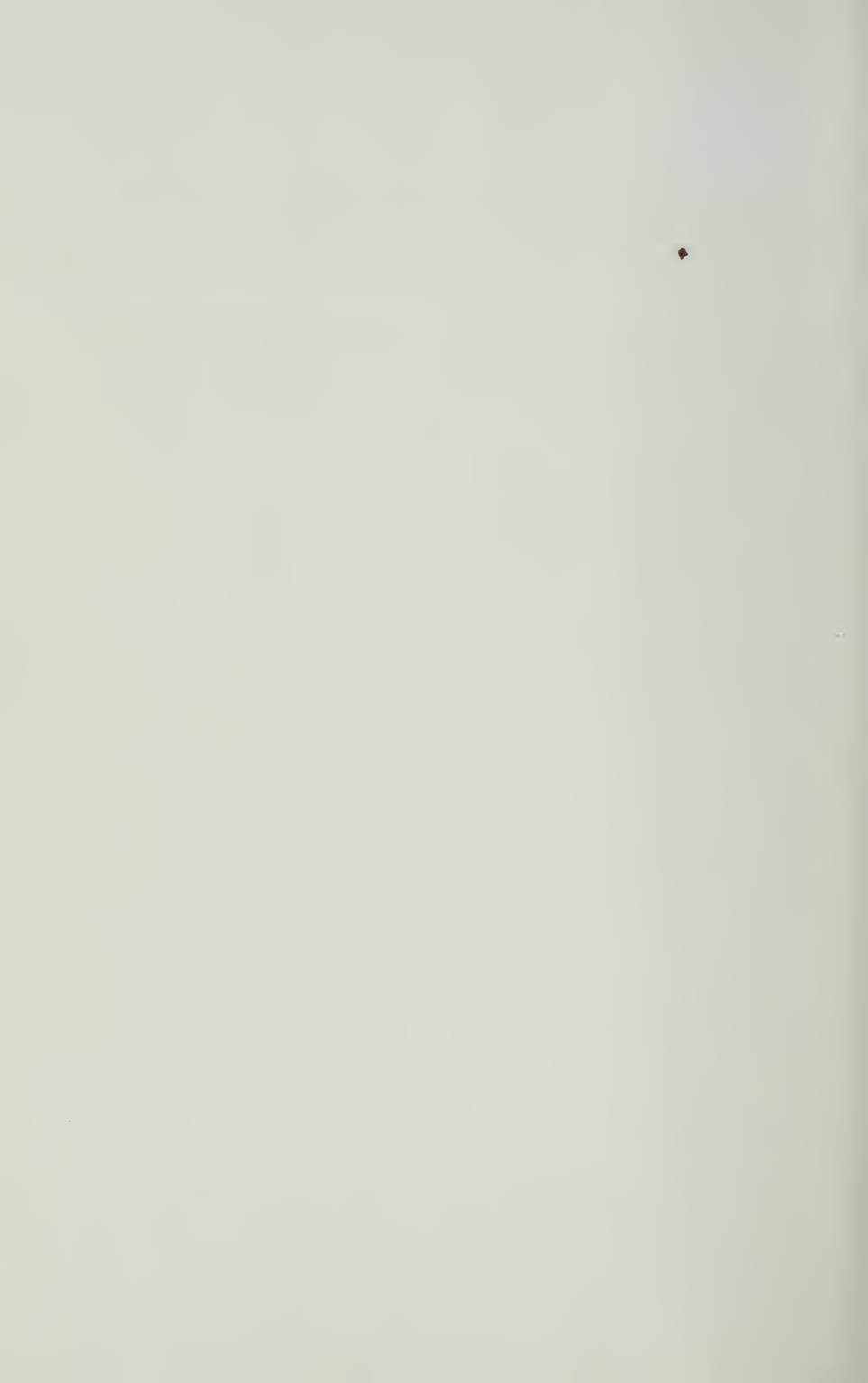
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The Graduate College

The University of Illinois
at
Chicago Circle

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Contents

Academic Calendar

1969-1970

Fall Quarter

September 22-26 (M-F)	Registration week
September 29, M	Instruction begins
November 27, 28 (Th, F)	Thanksgiving vacation
December 5, F	Instruction ends
December 8-12 (M-F)	Final examinations

Winter Quarter

December 15-19 (M-F)	Registration week
January 5, M	Instruction begins
March 13, F	Instruction ends
March 16-20 (M-F)	Final examinations

Spring Quarter

March 23-27 (M-F)	Registration week
March 30, M	Instruction begins
May 15, F	Honors Day
June 5, F	Instruction ends
June 8-12 (M-F)	Final examinations
June 14, Sun	Commencement

Summer Quarter

June 15-19 (M-F)	Registration week
June 22, M	Instruction begins
August 28, F	Instruction ends
August 1-September 4 (M-F)	Final examinations

1970-1971

Fall Quarter

September 21-25 (M-F)	Registration week
September 28, M	Instruction begins
November 26-27 (Th, F)	Thanksgiving vacation
December 4, F	Instruction ends
December 7-11 (M-F)	Final examinations

Winter Quarter

December 14-18 (M-F)	Registration week
January 4, M	Instruction begins
March 12, F	Instruction ends
March 15-19 (M-F)	Final examinations

Spring Quarter

March 22-26 (M-F)	Registration week
March 29, M	Instruction begins
May 14, F	Honors Day
May 30, Sun	Memorial Day
May 31, M	Memorial Day holiday (no classes)
June 4, F	Instructions ends
June 7-11 (M-F)	Final examinations
June 20, Sun	Commencement

Summer Quarter

June 14-18 (M-F)	Registration week
June 21, M	Instruction begins
July 4, Sun	Independence Day
July 5, M	Independence Day holiday (no classes)
August 27, F	Instruction ends
August 30-September 3 (M-F)	Final examinations

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Departments Offering Graduate Work

Anthropology
Charles A. Reed, Acting Head
3102 Behavioral Sciences Building

Biological Sciences
John O. Corliss, Head
Science and Engineering South

Chemistry
William F. Sager, Head
400 Science and Engineering South

Energy Engineering
James P. Hartnett, Head
912 Science and Engineering Offices

English
John C. Johnson, Acting Head
2131 University Hall

Geological Sciences
Werner H. Baur, Head
2462 Science and Engineering South

German
Robert R. Heitner, Head
1605 University Hall

History
Robert V. Remini, Chairman
1928 University Hall

Information Engineering
Herbert J. Stein, Acting Head
1120 Science and Engineering Offices

Materials Engineering
Ernest F. Masur, Head
816 Science and Engineering Offices

Mathematics
Joseph Landin, Head
322 Science and Engineering Offices

Philosophy
Donald A. Wells, Chairman
1803 University Hall

Physics
Swaminatha Sundaram, Head
2218 Science and Engineering South

Political Science
Richard M. Johnson, Head
1102 Behavioral Sciences Building

Psychology
Harry S. Upshaw, Acting Head
1008A Behavioral Sciences Building

Social Work
George W. Magner, Acting Assistant Directo
1312 University Hall

Sociology
Robert L. Hall, Head
4118 Behavioral Sciences Building

Graduate College
1523 University Hall
The University of Illinois at Chicago Circle
Box 4348
Chicago, Illinois 60680

Campus History and Information

The University of Illinois at Chicago Circle was activated in 1965, not as a new institution but as the successor to the Chicago Undergraduate Division, through which the University of Illinois for 19 years provided the first two years of college and preprofessional work for over 100,000 commuting college students of the Chicago area.

In the spring of 1946 the University realized that men and women from the Armed Services could not be admitted to the main campus at Champaign-Urbana because it was impossible to construct additional facilities in time to meet the demand. Restricting enrollment was undesirable; therefore, Navy Pier, already used as a school and adaptable to the needs of a freshman-sophomore program, was leased by the Board of Trustees to organize the Chicago Undergraduate Division. That fall, 3800 students, three-fourths of them veterans, were enrolled. Although the percentage of veterans dropped slightly in 1947, enrollment rose above 4500.

In January, 1961, the Board of Trustees approved the granting of baccalaureate degrees by the Chicago Undergraduate Division as soon as an adequate campus was available: the site, where the Eisenhower, Ryan, and Kennedy Expressways converge, was selected in 1961, the Chicago Undergraduate Division became the University of Illinois at Chicago Circle, and the campus was occupied on February 22, 1965.

Thirteen graduate programs were offered in September, 1967. Subsequently, additional Master's programs and seven doctoral programs have been approved. In the near future additional departments will offer work for the M.A., the M.S., and the Ph.D. degrees. Professional programs will also be initiated soon.

Other University of Illinois facilities in Chicago are at the Medical Center, which houses the Colleges of Medicine (including the School of Associated Medical Sciences), Dentistry, Nursing, and Pharmacy and the Health Sciences Division of the Graduate College.

Location and Transportation

The Chicago Circle campus is located just south and west of the Loop in an area bounded by the Eisenhower and Ryan Expressways, Racine Avenue, and

Roosevelt Road. The mailing address is Box 4348, Chicago, Illinois 60680. Transportation to the campus is by way of the CTA, which has built a station at Peoria Street especially to serve Chicago Circle, and by the buses on Halsted, Harrison, and Taylor Streets and on Roosevelt Road.

Programs

The Graduate College of the University of Illinois at Chicago Circle offers programs leading to the Master's degree in these disciplines:

Anthropology	Materials Engineering
Biological Sciences	Mathematics
Chemistry	Philosophy
Energy Engineering	Physics
English	Political Science
Geological Sciences	Psychology
German	Social Work
History	Sociology
Information Engineering	

Programs leading to the doctorate are offered in the following fields:

Chemistry	Mathematics
Engineering	Philosophy
(Solids and Fluids)	Physics
History	Psychology

Admission

The academic year at Chicago Circle consists of three 11-week quarters (including the final examination periods), which begin in September (fall quarter), January (winter quarter), and March (spring quarter). The 11-week summer quarter begins in June. A student may seek admission to any one of the four quarters.

Inquiries about admission and related matters should be directed to the department in which the applicant wishes to enroll. To be considered for admission to the Graduate College, the applicant must meet these conditions:

1. He must be a graduate of an institution awarding a baccalaureate degree comparable to that granted by the University of Illinois.
2. He must be adequately prepared for advanced study as demonstrated by his previous program of study and his scholastic record.
3. He must be recommended for admission by the department to which he has applied and by the Dean of the Graduate College. Departmental recommendation is based on factors that include but go beyond a satisfactory scholastic average; hence, an acceptable scholastic average alone does not insure admission.
4. He must present a minimum admission average of 3.50 (A=5.00), which is computed on the basis of the last 60 semester hours or 90 quarter hours. Some departments require a higher admission average; consult the section of this publication that pertains to the several departments. An applicant with an average of less than 3.50 should not apply. Several departments advise applicants to take the Graduate Record Examination or to provide further evidence of scholastic attainments.

An applicant for post-Master's work and doctoral candidacy who has earned a Master's degree or at least 48 quarter hours (32 semester hours) of graduate study is considered for admission on the basis of two scholastic grade-point averages: one, for the last 90 quarter hours (60 semester hours) of undergraduate study; the other, for all graduate course work completed at the time of application. Credit for work completed elsewhere is described in *Academic and General Regulations.*

Admission of Foreign Students

A foreign student must meet all of the foregoing requirements and must pass the English Proficiency Test, as explained below. He should also submit with his initial inquiry copies of his complete official academic records which have been certified by the educational institutions he has attended. Included must be a list of all degrees, diplomas, or certificates awarded and an authenticated translation of all documents submitted in a language other than English. In order to allow sufficient time for processing foreign student applications, requests should reach the departmental office four to six months before the beginning of the quarter to which the applicant seeks admission.

Because it is not advisable to undertake a graduate program at the University of Illinois at Chicago Circle without competence in the English language, an applicant whose native tongue is not English is required to take an English proficiency test. Arrangements for this test (TOEFL) may be made by writing to:

> Test of English as a Foreign Language
> Educational Testing Service
> Princeton, New Jersey 08540.

The test is administered in October, January, April, and June.

The applicant must request that the Educational Testing Service forward the results of the TOEFL to the Office of Admissions and Records. Upon receipt of the completed application form, English test results, required credentials, and a favorable recommendation from the applicant's major department, the Office of Admissions and Records will issue appropriate documents of admission including a certificate to apply for a visa to enter the United States.

Applications

Applications for admission may be obtained from the department to which the student is applying, from the Office of Admissions and Records, 209 Racine Avenue Building, or from the Graduate College, 1523 University Hall. Department offices are listed on page 000. A prospective student should apply for admission at least two months before the beginning of the quarter in which he expects to enroll. The deadlines for receipt of completed applications for admission to a specific quarter, together with all required supporting documents, are:

> Fall quarter, August 31.
> Winter quarter, December 15.
> Spring quarter, February 15.
> Summer quarter, May 15.

Applications will be acted on only when official copies of all transcripts and other credentials have been received by the department in which the applicant wishes to enroll and the Office of Admissions and Records.

A nonrefundable advance deposit of $31 on tuition and fees will be requested of all applicants who have been approved for admission or readmission (including all foreign students presently residing in the United States). The Office of Admissions will send an official request for the deposit. Graduate students assured of the award of a fellowship, assistantship, or tuition-and-fee waiver are exempt from the required deposit.

Upon notice from the Business Office that the deposit card has been returned, the Office of Admissions and Records will mail the official Permit to Enter and registration instructions. Registration cannot be completed without the permit form. The Office of Admissions and Records will also issue official certificates of admission for foreign students to obtain the necessary visas.

Medical examinations are required of all students before their first registration. The examination is made by the family physician at the student's expense.

Off-Quarter Vacation

A student may elect to attend any three consecutive quarters out of four; hence, if he chooses to use a quarter other than the summer as his vacation (or off quarter), he must file an application with the Office of Admissions and Records before the first day of instruction of the quarter he wishes to use as vacation. Application blanks for this purpose are available in the records department of that office.

Commitment for Readmission to a Future Quarter

Students who find it necessary to be away from campus (not registered) for more than one quarter may be granted a commitment for readmission to a future quarter. Such action is initiated by a request from the student's department to the Graduate College specifying the length of time and reasons for the absence. After approval by the Graduate College the petition and application for readmission to the future quarter will be forwarded to the Office of Admissions and Records, which will issue a readmission commitment letter.

Readmission

An application for readmission is required of all former students who have not registered for one or more quarters (without off-quarter vacation). Applications should be submitted no later than two weeks prior to the beginning

of the session in which the student plans to register. A nonrefundable deposit of $31 will be requested by the Admissions Office. This deposit is required of all students seeking readmission unless they have been awarded financial aid. Upon receipt of the requested deposit an official notice of readmission will be issued by the Office of Admissions and Records. Registration may not be completed without this notice.

Work Completed Elsewhere

A student who has completed graduate courses in a recognized institution without receiving a degree may petition the Graduate College for credit toward an advanced degree after consultation with his adviser and his department. Recommendation for allowance (or disallowance) of transfer credit is a departmental matter. The department concerned shall submit to the Graduate College its recommendations including the courses requested for credit transfer, those allowed, those disallowed, and the applicable grades. Courses applied toward an undergraduate program leading to a Bachelor's degree may not be counted. The number of credits which may be transferred is determined on an individual basis. Six quarter hours are the equivalent of 4 semester hours (or, at the Urbana Campus, 1 semester unit of graduate credit). Most graduate courses carry 4 quarter hours of credit.

Graduate Study by Seniors at the University of Illinois. Upon recommendation of the department, an undergraduate student may be given graduate credit for graduate courses taken in his senior year, if credit for such courses is not to be applied toward the fulfillment of requirements for the baccalaureate degree.

Academic and General Regulations

A student should familiarize himself with the academic requirements and regulations of the Graduate College and of the department in which he is working. He is responsible for complying with these regulations and for fulfilling all requirements for his particular degree. Every graduate student should have a Graduate College Catalog and, if available, a departmental brochure, for they are official statements of policy. The usual procedures and requirements of the Graduate College are indicated in this Catalog.

Petitions

A student may petition the Dean of the Graduate College for exceptions to any of the following regulations, but he should do so only after consultation with his adviser and the departmental coordinator of graduate studies. Forms for such petitions may be secured from the Graduate College.

Residence

Each degree candidate must spend these periods of time in residence:

For the Master's degree: 24 hours in regularly scheduled courses taken within one calendar year. Exceptions to this requirement, e.g., for students with acceptable transfer credit or part-time students, may be granted by the Graduate College upon recommendation of the department.

For the degree of Doctor of Philosophy: 24 hours beyond the Master's level (or its equivalent) in regularly scheduled courses (excluding Thesis Research) must be earned at the University of Illinois at Chicago Circle. Three consecutive quarters of at least 8 hours per quarter (which may include Thesis Research) must be taken at Chicago Circle. Exceptions may be granted by the Graduate College upon recommendation of the department.

Time Limitations for Advanced Degrees

A candidate for a Master's degree must complete all requirements for the degree within four calendar years after his initial registration in the Graduate College. Doctoral candidates must complete their degree requirements within six years after receiving the Master's degree or its equivalent. In special circumstances the student, on consultation with his adviser, may petition the Graduate College and his department for an extension of this time limit.

Advisers

Each graduate student must have an adviser in the department in which he is a degree candidate. The adviser assists in planning a program of graduate study which fits the needs of the student and satisfies departmental and Graduate College requirements. A new student should contact his major department to discuss the selection of an adviser. Many departments have a coordinator of graduate studies whose responsibilities include direction of all graduate work in that department.

Courses of Instruction

Courses open to graduate students are of two types. Those numbered from 300 to 399 are open to advanced undergraduate and graduate students. Those numbered 400 to 499 are generally open only to graduate students. Some 300-level courses are available for graduate credit in departments other than those offering advanced degrees. Students should consult their advisers about the possibility of using these courses as minors.

A number of courses offer variable credit. At the 300 level, additional work in the nature of special reports, papers, or projects is required of a student who registers for the maximum credit shown. At the 400 level, some research, reading, and independent courses provide variable credit; proportionate time devoted to a particular activity can thus be indicated on the student's record.

Prerequisites. Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

Grades

Minimal Grade Requirements. A student may be dropped by the Graduate College upon recommendation of the department. If the cumulative average of courses taken for credit falls below 3.50 at the end of any quarter, the student

will be placed on probation. If the cumulative average remains below 3.50 at the end of the regular academic year (or at the end of any three quarters), the student will be dropped from the Graduate College. Departments may set higher standards.

EX and DF. At the end of a continuing course sequence the deferred grade for all quarters must be converted either to a specific letter grade or to the Ex grade. Deferred grades should be used only for 499 (Thesis Research), other research, continuing seminar or sequential courses, and independent study.

Pass-Fail Grades. A graduate student may take courses on a pass-fail basis provided that:
1. the courses are not within the student's immediate area of specialization;
2. such courses account for no more than 1/6 of the total number of course hours taken at the University of Illinois at Chicago Circle and counted toward the degree;
3. the student declare his intention to take a course on this basis at the time of registration.

Drop Rule. Until the end of the sixth week of the quarter a student may drop a course without penalty. Thereafter the course may not be dropped.

Maximum and Minimum Registration

The academic work carried by assistants and others on the University staff is limited by statute, and those employed outside the University are expected to plan their programs of study in accordance with these regulations. Students holding University Fellowships or other fellowships awarded by the University must carry a full program of 16 quarter hours or the equivalent. Those awarded tuition-and-fee waivers must carry a minimum program of 12 quarter hours or the equivalent. The academic work carried by a graduate student who holds an assistantship is limited by statute as follows:

Appointment	Maximum hours per quarter
Full	4
3/4	8
2/3	9
1/2	12
1/3	15
1/4	16

Auditing Privileges

A graduate student regularly registered may be permitted to attend classes as an auditor without credit at the discretion of the instructor in charge of the course. Students who wish to have their audited courses recorded must pay the Course-Visitor-Auditor fee (see Tuition and Fees). Persons not registered at the University of Illinois are permitted to attend classes, other than laboratory courses, as auditors, provided they pay the fee and file with the Office of Admissions and Records a permission form bearing the approval of the instructor and the Dean of the Graduate College. A student should not enter on his program card any courses which he plans to attend as an auditor.

Regulations Pertaining to Degrees

The Master's Degree

The following are the requirements of the Graduate College only; departmental requirements are in addition to them. A minimum of 48 quarter hours is required for the Master's degree. At least 16 of the 48 quarter hours must be in courses numbered 400 and above, and 12 of these 16 must be in the major field. At least 24 quarter hours must be taken in the major field of interest; the remaining credit may be in that field or in other courses appropriate to the student's educational goals. No more than 18 quarter hours of credit in 499, Thesis Research, may be included in a 48-hour program. The normal load is 16 quarter hours; however, a student is classified as full time if he is registered for 12 quarter hours or more. Under special conditions and with the approval of his adviser a student is permitted to register for up to 20 quarter hours. Twenty-four quarter hours (which may include Thesis Research) must be earned at the University of Illinois at Chicago Circle. Exceptions may be granted by the Graduate College upon recommendation of the department.

Examination for the Master's Degree. Examination requirements, if any, are determined by the department. The Graduate College shall have the recommendation of a departmental committee consisting of at least three persons, one of whom must have at least Master's standing or the equivalent.

Thesis. A student electing or required to write a Master's thesis should file the title of the thesis with the Graduate College at least six weeks prior to graduation. No more than 18 quarter hours of thesis credit may be included in a 48-quarter-hour program. Credit in thesis research cannot be applied to a degree until the thesis is accepted. For specific instructions on the format of the thesis the student should obtain a copy of the leaflet, "Instructions for Preparation of Theses," from the Graduate College Office, 1523 University Hall.

The Doctoral Degree

The degree of Doctor of Philosophy is offered in chemistry, history, mathematics, philosophy, physics, psychology, and solids and fluids engineering. The general requirements for this degree are described below, and any special requirements are given in the departmental listings.

Each student's schedule of course work and research is planned in consultation with his adviser with consideration given to the candidate's previous training, his career objective, the general regulations of the Graduate College, and any specific departmental requirements. It is the student's responsibility to be aware of these regulations and requirements and to satisfy them as early as possible. The major area of specialization consists of a selection of courses closely related to each other, not all of which are necessarily offered by the major department. If a student elects or is required by departmental regulations to declare a minor outside his major department, the selection of courses must be approved by the departments or divisions concerned. A minor area of specialization consists of a group of course offerings that have a distinct relationship, though they may be offered in more than one department.

Foreign Language Requirement. The foreign language requirement for the degree of Doctor of Philosophy is left to the individual department, division, or jointly administered program, subject to the approval of the Graduate College.

Examinations. The Graduate College requires two examinations, and a committee will be appointed for each. The first examination, called the preliminary, is an examination of the candidate's grasp of the field of his major (and minor) subjects. The second is an examination on the candidate's dissertation. The department may have additional requirements.

The committee for the preliminary examination shall consist of at least five persons representing the major and minor areas, one of whom may be from outside the department or from outside the University. Members of the committee will be appointed by the Dean of the Graduate College on recommendation of the department. The chairman and at least one other member must have full standing or the equivalent.

The preliminary examination may be written, oral, or both at the discretion of the department. The timing is also at the discretion of the department. The recommendations of the department, including the action of the committee, shall be reported to the Graduate College. Part of the report will be a summary of the votes of the committee members. The total vote shall be pass, conditional (specified), or fail. A candidate may not be passed if he receives more than one vote of fail. When there is no unanimity, the Graduate College will act as arbitrator. The Dean, in consultation with the department head and the committee chairman, may allow the candidate to be given a second examination at some later date. The second committee may consist of the same examiners. No more than two preliminary examinations may be given.

The dissertation committee shall follow the foregoing regulations except that

the minimum membership shall be three, of which the chairman and one other member must have full standing or the equivalent. The candidate is admitted to the final examination upon recommendation of the major department.

Thesis. The degree of Doctor of Philosophy is primarily a research degree and the candidate must demonstrate his capacity for independent research by the presentation of an original thesis on a topic within his major field of study. The subject of the thesis must be reported to the doctoral committee and to the Graduate College at the time of the preliminary examination. The candidate must register each term, except summer quarters, until he receives his degree. When the credit requirement is satisfied (144 quarter hours of courses and thesis research beyond the Bachelor's degree), the student maintains his status as a candidate by registering for zero credit in 499, Thesis Research. Candidates engaged in thesis research may find it desirable or expedient to publish prior to the conferring of the degree certain findings that later will be incorporated in the dissertation. In this case, appropriate acknowledgment of the earlier publication should be included in the dissertation. The Graduate College encourages such publication, but the thesis in its entirety may not be published before all degree requirements have been completed. Directions regarding the format of the thesis are given in the leaflet, "Instructions for Preparation of Theses," which may be obtained in the Graduate College office. The candidate must submit to the Graduate College office, no later than the date specified in the current calendar of the College, the original and first carbon copy (or two copies reproduced by an approved method) of his thesis and one typewritten copy of an abstract not exceeding 600 words. Each candidate who passes the final examination must pay a $25 microfilm fee. This provides for microfilming the complete thesis, with one copy deposited in the University of Illinois library, and publication of the abstract in *Dissertation Abstracts.*

Tuition, Fees, and Other Charges

All students are assessed tuition and fees which are payable in full as part of registration. Arrangements to defer payment under special circumstances may be made with the Business Office. The amount of tuition and the service fee vary with the number of credit hours for which the student registers. Tuition (but not the service fee) also varies according to the resident or nonresident status of the student in the State of Illinois.

Tuition and Fees

| | Full Program Range I Above 10 quarter hours | | Partial Program | | | |
| | | | Range II From 6 to 10 quarter hours | | Range III From 1 to 5 quarter hours | |
	Resident	Non-Resident	Resident	Non-Resident	Resident	Non-Resident
Tuition (except those holding exemptions)	$ 82	$284	$ 58	$200	$ 34	$114
Service Fee	32	32	24	24	14	14
Hospital-Medical-Surgical Insurance Fee	7	7	7	7	7	7
Total	$121	$323	$ 89	$231	$ 55	$135

Tuition and Fee Deposit. The University requires a non-refundable $31 advance deposit, payable when an applicant receives notice of admission. This deposit reserves the applicant a place only in the session to which he has been admitted. It is applied to his tuition and fees for that quarter; it cannot be applied to any subsequent quarter should he fail to enter in the quarter to which he has been admitted.

Residence Classification. The residence classification of an applicant is determined on the basis of information given on his application and other

credentials. Fees are assessed in accordance with this decision. If the student believes he has a legitimate cause for change of status, he may petition for a change on a form provided by the Office of Admissions and Records. Petitions are considered within thirty days from the date designated in the official University Calendar as that upon which instruction begins for the academic period for which the fee is payable. However, if the nonresident fee was not assessed on or prior to that date, the claim for refund may be filed within thirty days after the nonresident fee was assessed and the student was given notice of its assessment. Tuition and fees will not be adjusted for that academic term unless the petition is filed within these time limits. Additional evidence to substantiate a request may be required. If the student expects to ask for a change of residence classification, it is advisable for him to request that the adjustment be made prior to the registration period.

In the event a student who claims he is a resident is dissatisfied with an adverse ruling of the Director of Admissions and Records, he may obtain a review of such decision by the Legal Counsel of the University by filing a written request with the Director of Admissions and Records within twenty days after he has been notified of the ruling.

Further information concerning residency may be secured from the Director of Admissions and Records. A brochure entitled *Regulations Governing Assessment of Resident or Nonresident Student Fees* is also available.

Exemptions

A student may be exempted from one or more of the following charges if he qualifies under the stated conditions:

Tuition is waived for:
1. Holders of tuition-waiver scholarships.
2. All academic employees of the University or allied agencies on appointment for at least 25 percent but not more than 67 percent of full-time service.
3. All permanent nonacademic employees of the University or allied agencies on appointment for at least 25 percent of full time who register in University courses in Range II or III.
4. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
5. Holders of grants or contracts from outside sponsors which provide payments to cover the total costs of instruction.
6. Teachers and administrators who cooperate in the practice teaching program. (Exemption is allowed for each quarter of assignment within the same calendar year – September through August.)
7. Persons registered in noncredit seminars only.
8. University employees registered at the request of their departments in

noncredit courses especially established to improve the work of the employee.

9. Academic staff members emeriti.

The nonresident portion of tuition (if the enrollee is subject to payment of tuition) is waived for:

1. All staff members (academic, administrative, or permanent nonacademic) on appointment for at least 25 percent of full time with the University or allied agencies.
2. The faculties of state-supported institutions of higher education in Illinois.
3. The teaching staff in private and public elementary and secondary schools in Illinois.
4. The spouses and dependent children of those listed in items 1 and 2. (Dependent children are those who qualify as dependents for federal income tax purposes.)
5. Persons actively serving in one of the Armed Forces of the United States who are stationed and present in the State of Illinois in connection with that service.
6. The spouses and dependent children of those listed in item 5, as long as they remain stationed, present, and living in Illinois.

Assessments and Exemptions

For fee assessment purposes, a staff appointment requires service of not less than three-fourths of the term. This is interpreted as a minimum of nine weeks in a quarter. Staff tuition-and-fee privileges do not apply to students employed on an hourly basis in either an academic or nonacademic capacity or to persons on leave without pay.

For fee assessment purposes, a permanent nonacademic employee is defined as a person who has been assigned to an established, permanent, and continuous nonacademic position and who is employed for at least 25 percent of full time. University employees appointed to established civil service positions whose rate of pay is determined by negotiation, prevailing rates, or union affiliation are entitled to the same tuition-and-fee privileges accorded other staff members under the regulations.

A student who resigns his staff appointment, or whose appointment is cancelled before rendering service for at least three-fourths of the term, becomes subject to the full amount of the appropriate tuition and fees for that term unless he withdraws from his University classes at the same time the appointment becomes void, or unless he files clearance for graduation within one week after the appointment becomes void.

Fees

The Service Fee is applied toward the operating expense of Chicago Circle Center, the financing of the Center building, and the cost of the Student Activities Program.

The service fee is waived for:
1. All staff members of the University or allied agencies who are on appointment for at least 25 percent but not more than 67 percent of full time.
2. Holders of graduate tuition-and-fee waivers awarded by the Graduate College.
3. Students registered *in absentia.*
4. Students registered in courses taught off campus.
5. Holders of grants or contracts from outside sponsors if the service fee is charged to the contract or to grant funds.
6. Cooperating teachers and administrators described under *Exemptions,* item 6.
7. Persons registered in noncredit seminars only.
8. University employees registered at the request of their departments in noncredit courses especially established to improve the work of the employee.
9. Emeriti.

The Course-Visitor-Auditor Fee of $15 is assessed all class visitors who are not in Range I in the tuition-and-fee schedule.

The Late-Registration Fine of $15 is levied against all students who complete registration after classes have begun.

The Hospital-Medical-Surgical Insurance Fee is the same for all students, regardless of the number of hours for which they are enrolled or of their Illinois residence status. All students enrolled and in attendance at Chicago Circle are covered by a health insurance policy, for which they pay a fee of $7 per quarter at registration. Eligible dependents of insured students (spouse and/or unmarried dependent children under nineteen years of age) may also be insured if the student makes application to the University Cashier (Room 406, University Hall) within the time specified by the insurance policy.

If a student withdraws from the University, he does not receive a refund since he remains insured for the balance of the quarter from which he withdrew. Special provisions exist for students to be covered by this insurance during the summer months, irrespective of their registration for that part of the year. For further information, consult the Insurance Office, Room 420, University Hall.

If a student presents evidence of insurance in force which provides him equivalent coverage, he may petition the University Insurance Office for a refund of this fee. Refunds are not made on any other basis. The student should

also consult the Insurance Office about the time limit for such a refund petition.

Transcript Fee. A student is issued one transcript of his record without charge. For each additional transcript, a fee of $1 is assessed.

Refunds

Students who withdraw from the University or from a course are entitled to a refund of a portion of the tuition and fees, if they have been paid, under the following circumstances:

On Withdrawal from the University: The full amount of tuition and fees assessed, *except for a $31 nonrefundable service charge*, is refunded to the students who withdraw *within the first ten days* of instruction in a quarter. After the tenth day of instruction and before the middle of the quarter, one half of the amount assessed, *except for a $31 nonrefundable service charge*, is refunded. No refund is issued after midquarter.

No refund is issued if the total assessment was less than $31 (for example, a student on a tuition-waiver scholarship).

On Withdrawal from a Course: If such withdrawal results in a reduction in the student's program to a lower tuition-and-fee range, the full difference is refunded during the full-rebate period; half the amount of the difference is refunded when withdrawal occurs during the half-rebate period; no refund is made if withdrawal occurs thereafter. See the quarterly Timetable for specific dates for each quarter.

On Withdrawal by a Visitor-Auditor: A full refund will be issued if the withdrawal is made within ten days after payment of fees. Thereafter, no refund will be made.

On Withdrawal to Enter Military Service: If withdrawal occurs during the first six weeks of instruction, the student is entitled to a full refund of his tuition and fees, less the Hospital-Medical-Surgical Insurance fee. If withdrawal to enter military service occurs between the fifth and eighth weeks of instruction, the student will receive a one-half refund of his tuition and fees (less the Hospital-Medical-Surgical Insurance fee). When the withdrawal occurs after the fifth week of instruction, under certain circumstances, the student may receive partial or full credit in some of the courses in which he is registered at the time of the withdrawal. Further information is available in the Graduate College, 1523 University Hall.

No refund of tuition and fees is made after the eighth week.

Assistantships, Fellowships, and Financial Aid

Various types of financial assistance are available each year to promising students in all fields of study in the Graduate College. For the most part, the information in this section deals with aid administered by the University of Illinois. It should be noted, however, that there are also a number of nationally sponsored fellowships that provide support for graduate students for study either at the University of Illinois or elsewhere. Among these are the National Science Foundation fellowships and traineeships and the Woodrow Wilson fellowships. Other fellowships are offered through foundations, industrial concerns, and individuals. Further information and application procedures for nationally sponsored fellowships may be obtained by writing directly to the agency concerned or, in most instances, to the University department in which the student plans to major.

The University of Illinois directly administers five main types of financial aid for graduate students: fellowships (including traineeships), assistantships both in teaching and research, tuition-and-fee waivers, loans, and employment. Each type is described in the following sections.

Fellowships

Fellowship stipends are gratuities awarded in recognition of scholarly achievement and promise. They enable a student to pursue his graduate studies and research without requiring him to render any service. The stipends of different fellowships vary, but with few exceptions they are currently not less than $2,000 for the nine-month academic year. The fellow's stipend is legally regarded as a gift, not as compensation for services rendered, and is, therefore, exempt from income tax. Unless explicitly stated otherwise, all fellows whose appointments are administered by the Graduate College are exempt from tuition and fees. A fellow is required to pursue a full program of graduate study (at least 16 quarter hours per quarter) and may not engage in remunerative employment, other than an assistantship for University Fellows, without the permission of the Dean of the Graduate College.

University Fellowships are awarded on the basis of an all-University competition and are not restricted to any particular field of graduate study. University

Fellowships are for nine months and carry a stipend of not less than $2,000 plus exemption from tuition and all regular fees except the Hospital-Medical-Surgical Insurance Fee.

A student receiving a University Fellowship is also eligible to accept a part-time assistantship up to a maximum of one-quarter time. Under such an appointment, the fellow's basic stipend remains unchanged and tax-free, but the salary for teaching is subject to income tax. University Fellows who also hold an assistantship must carry full programs of graduate study (at least 16 quarter hours per quarter) unless expressly authorized by the Dean of the Graduate College to carry reduced programs. Students whose first interest is in teaching should so indicate on their applications.

Industrial, Endowed, and Special Fellowships. Various industrial firms, foundations, and private individuals have generously donated funds to support a number of special fellowships for graduate students at the University of Illinois. The stipends and supplemental allowances of these fellowships are not uniform, and most of them are restricted to students in particular areas of study. Further information may be obtained from the department in which the student plans to register.

National Science Foundation Traineeships. Under this program, grants are made directly to the participating institutions, which select promising individuals for full-time graduate study. Appointments may be made only from among citizens of the United States (or native residents of a United States possession) who are enrolled in programs leading to an advanced degree in the mathematical, physical, medical, biological, and engineering sciences, anthropology, economics, the history and philosophy of science, linguistics, political science, psychology, and sociology. Also included are the interdisciplinary areas which comprise overlapping fields among two or more sciences (for example, geochemistry, meteorology, and oceanography).

Trainees must devote full time to programs leading to advanced degrees and may be appointed for either nine or twelve months. A school may require or permit a trainee to include in his training program teaching which contributes to his academic progress.

The basic stipend for a twelve-month award is $2,400 for the first year, $2,600 for the intermediate year, and $2,800 for the terminal-year level. An allowance of $500 is granted for each dependent. For nine-month awards, the allowance is prorated. Inquiries concerning traineeships should be directed to the department of the University in which the student is seeking a traineeship.

Assistantships

The various departments of the University employ graduate students as either teaching assistants or research assistants. The duties of a teaching assistant usually involve such activities as classroom instruction, supervision of a labora-

tory section, the guidance of discussion sections, and paper grading. Research assistants participate in research activities under the supervision of University faculty members. In some instances the work of a research assistant may be related to his thesis research; in others it may be entirely different. Although most research assistantships are awarded to graduate students who have completed one or more quarters of graduate work at the University of Illinois, new students are eligible for such appointments. Each assistant is paid a salary for services rendered, and, under present ruling, this salary generally is subject to income tax.* Assistants holding more than one-fourth-time appointments are normally not permitted to carry full programs of graduate study during the period of their appointments.

Nature of Appointment	Maximum Registration per Quarter	Expected Clock Hours of Service per Week
	Quarter Hours	
Full Time	4	37½
Three-fourths time	8	29
Two-thirds time	9	25½
One-half time	12	19
One-third time	15	12½
One-quarter time	16	9½

Those whose appointments range from 25 to 67 percent are exempt from tuition and all fees except the Hospital-Medical-Surgical Insurance fee. The above table lists the provisions of various assistantships. Applications may be made directly to the relevant University department.

Graduate students who hold academic appointments for the winter and spring quarters of one academic year, either as employees or fellows, and for whom tuition and/or fees have been provided through waiver or through cash payment by an outside agency, are entitled to a waiver of the same kinds of tuition and fees for the summer quarter immediately following, provided they do not hold appointments during that summer quarter.

Tuition-and-Fee Waivers

A graduate tuition-and-fee waiver provides exemption from tuition and all incidental fees (except the Hospital-Medical-Surgical Insurance fee) for the academic year and the following summer quarter. To hold these awards students

*The District Director of Internal Revenue has ruled that under certain conditions income tax need not be withheld from remuneration paid to research assistants engaged in thesis research.

must be in residence and must register for at least twelve hours per quarter during the academic year, including the summer quarter. They may, however, accept part-time or incidental employment not to exceed twenty hours a week either within or without the University.

Veterans who are admissible to a graduate program and who meet certain residence requirements may be eligible for exemption from tuition and certain fees under the State statute covering Military Scholarships. Further information may be obtained from the Office of Financial Aid, Room 850, University Hall.

How to Apply

Application materials and instructions may be obtained from the Graduate College or from any graduate department. Only one application form is needed to apply for any of the types of financial aid listed.

To be considered for a University Fellowship beginning in September, the application must be filed with the major department no later than the preceding February 15. Applications for tuition-and-fee waivers and assistantships are accepted by the departments after that date, but applicants for such appointments are strongly urged to submit their applications as early as possible since many departments offer their assistantships at the same time they consider applications for fellowships.

Announcement of Awards

Fellowship awards are announced by the Graduate College on or about April 1. Recipients are expected to accept or decline by April 15. The University of Illinois adheres to the following resolution adopted by the members of the Association of American Universities and a number of other graduate schools in North America.

> In every case in which a graduate assistantship, scholarship, or fellowship for the next academic year if offered to an actual or a prospective graduate student, the student, if he indicates his acceptance before April 15, will still have complete freedom to reconsider his acceptance and to accept another fellowship, or graduate assistantship. He has committed himself, however, not to resign an appointment after this date unless he is formally released from it.

Loans

Long-Term Loan Funds are available to those students who have a demonstrated financial need. Loans approved by the Director of Financial Aid are subject to the availability of funds, and no commitment is made until all financial information has been reported. The signature of a qualified endorser or

satisfactory collateral is required for all long-term loans. Exceptions to this requirement may be made by the terms of the loan fund or may be waived in meritorious cases by the Director of Financial Aid. Each application must be signed by the applicant's department chairman.

Students must be in good standing before an application is accepted for processing. If loans are valid for a three-quarter period, the student must remain in good standing to receive a second advance. Any exceptions to this rule must be requested from the Office of Financial Aid. The Office of Financial Aid maintains a list of loan sources, such as private foundations, church-related sources, and bank sources in addition to those below. This information will be provided upon request.

University Loans. A student may borrow from the University Loan Fund an amount not to exceed $1,000 per year or a total of $2,500. He must being to repay his loan, at an interest rate of 3 percent annually, within four months after leaving the University, and he has up to four years in which to make complete repayment.

National Defense Education Act Loans. A graduate student may borrow money from funds provided to the University under Title II of the National Defense Education Act. The limit is $2,500 per year, to a total of $10,000. He must begin to repay his loan, at an interest of 3 percent annually, nine months after he has ceased to pursue a full-time course of study at the University, and the entire loan must be repaid within ten years after repayment begins.

It should be noted, however, that up to 50 percent of a National Defense Education Act loan will be cancelled if the borrower serves as a full-time teacher in a public or nonprofit private school in the United States. This applies to elementary or secondary schools, as well as to institutions of higher education. Such cancellation will be at the rate of 10 percent of the loan for each academic year of such service. Teaching in designated "hardship" areas carries loan cancellation up to 100 percent.

Cosigners are not required for NDEA loan funds.

United Student Aid Fund Loans. A graduate student may borrow up to $2,000 per year, to a total of $4,000. The amount of the loan will be determined on an individual basis. No notes under this plan may bear more than 6 percent simple interest. Repayments begin the first day of the fifth month after graduate education is completed. The normal repayment period is thirty-six months, but larger loans may be paid over periods ranging up to fifty-four months. Monthly installments may not be less than $30.

Illinois State Guaranteed Loans. The Illinois General Assembly has authorized an Illinois loan program to guarantee student loans made by commercial lenders to legal residents of the State of Illinois. An eligible student may borrow from a minimum of $300 to a maximum of $1,500. It is expected that a student will borrow only once during the academic year. Repayment does not begin

until the student either graduates or ceases full-time study. A loan will not be granted in an amount which exceeds the established educational expenses at the eligible college selected by the student, minus other scholarship or loan assistance. Applications may be secured from the Office of Financial Aid, 850 University Hall.

Short-Term Emergency Loans. Students may request short-term emergency loans from $5 to $100. The loan must be paid within forty-five days or by the end of the quarter, whichever date is earlier. Request forms may be obtained from the offices of the Dean of Men or Dean of Women, Room 827, University Hall.

Employment

The Student Employment Office, 812 University Hall, welcomes the opportunity to counsel students about employment. The office also offers students a library of job-reference materials, job listings, interviews, and referrals for employment to University departments and to agencies and business firms in the Chicago area. Securing a position through proper application and retaining that position through good work is, of course, the responsibility of the individual.

Campus Facilities and Student Services

Library

The University Library provides the books, periodicals, and related materials required to meet the instructional needs of the student. Library collections necessary for keeping scholars informed in their respective fields are currently in a state of rapid growth.

Government Documents. The Library has been a depository for United States government documents since 1957. The map collection contains topographical, army, and state highway maps. Numerous materials are available in microfilm or microprint.

The Department of Special Collections administers the Library's collection of maps and rare books and a growing collection of manuscripts. Included are materials in the fields of social welfare, politics, and labor, as well as those relating to various religious and ethnic groups in Chicago. Among these materials are the records of the Chicago Urban League, the Juvenile Protective Association, the Illinois Humane Society, the Chicago League of Women Voters, and the Metropolitan Housing and Planning Council of Chicago. The Jane Addams Memorial Collection, located in the restored Hull Mansion on the Chicago Circle campus, contains books, manuscripts, and memorabilia dealing with Miss Addams' life and work and with the social welfare movement. All such materials are available to faculty and graduate students for research.

The Urban Historical Collections contain several thousand items related to urban affairs, Negro history, social settlement work, Hull House, Chicago politics, and ethnic history, all of which are available for research not only to established scholars but to graduate students in urban-related disciplines.

A detailed outline of the general collections and suggestions for effective use of the library will be found in the Library Handbook, copies of which are available at all Library service desks.

The Computer Center

A grant from the National Science Foundation has enabled the University greatly to expand its computing resources on the Chicago Circle Campus, and in September, 1967, an IBM 360 model 50 computer with 262,544 bytes of core storage was placed in operation. Facilities have subsequently been expanded to include bulk core storage, increased disk capacity, and a process control computer for on-line monitoring of laboratory experiments.

The staff of the Computer Center teach courses in programming and numerical analysis, in cooperation with the Department of Mathematics and the College of Engineering. The staff also assist other departments in utilizing the equipment for both teaching and research throughout the campus.

Office of Instructional Resources

The Office of Instructional Resources, housed in the Library, is the agency responsible for planning, developing, and, when appropriate, administering technological aids to instruction and for advising and assisting the faculty in using these aids to improve the effectiveness and efficiency of instruction.

The Programmed Instruction Division works with faculty members in developing programmed instruction for academic courses and in locating and using programmed materials from outside sources. *The Television Division* produces and distributes instructional television presentations and supports other television applications in teaching. *The Audio-Visual Division* operates a media information and projection service and a professional facility for making slides, overhead transparencies, and handouts.

Laboratory Facilities

At present the Departments of Biological Sciences, Chemistry, Geological Sciences, and Physics, and the engineering sciences occupy research facilities in the Science and Engineering Laboratories, the twin buildings at the south end of the main campus. By the fall of 1969 the first four departments are expected to occupy, in addition, the new science and engineering center between Taylor Street and Roosevelt Road to the south of the present laboratories. These buildings afford considerable space for housing specialized equipment, the details of which are available from the department concerned.

The Phonetic-Linguistic Research Laboratory contains recording and specialized equipment patterned after a similar installation at the University of Hamburg.

The Behavioral Science Center contains research laboratories for demography, sociology, and psychology.

Facilities Within the City

The University of Illinois Medical Center departments cooperate with the Chicago Circle Departments of Biological Sciences, Chemistry, Psychology, and Sociology in encouraging joint graduate study, seminars, and the use of the Medical Library.

The Newberry Library (social sciences and humanities), the Crerar Library (science and technology), the Art Institute, the Field Museum of Natural History, the Museum of Negro History, the Library of International Relations, the Center for Research Libraries, the Chicago Historical Society, and the Chicago Municipal Reference Library are important nearby institutions for research.

Student Affairs

The Student Handbook, issued each fall, presents a wide variety of information about services available to students and regulations governing student life. Some of the services immediately relevant to many graduate students are described below:

Student Counseling Service. Interviews and psychological testing are available to all students and provide the basis for vocational or personal counseling by a professional staff.

University Health Service. The University provides clinic services for both preventive medicine and treatment. The cost of most medical expenses that cannot be assumed by the Health Service is covered by the student Hospital-Medical-Surgical Insurance, supervised by the Insurance Division of the Business Office, at a cost to the student of $7 per quarter.

Beds are provided for the temporary day care of sick or injured students. The University does not provide hospital care for its students, the large majority of whom are from families living in the Chicago area; hence, cases requiring bed care are referred to the student's family doctor and to hospitals of the community.

Coordinator of Foreign Student Affairs. Foreign students are assisted in evaluating their abilities and interpreting regulations applicable to them. This service includes assistance on problems of extension of stay, employment, border crossing, the details of maintaining legal status, housing, and understanding of the American way of life.

Speech Clinic. Students who wish assistance in correcting speech difficulties, including those arising from foreign accents, hearing deficiencies, and vocal or articulatory problems, should avail themselves of the services of this clinic. There are no fees for these services. The clinic is located in 202 Grant Hall.

The Departments

Note: All departmental admission and degree requirements are in addition to those of the Graduate College. Students must familiarize themselves with *both* sets of requirements.

Prerequisites: Exceptions to prerequisites listed in course descriptions in this catalog may be granted only with the consent of the instructor and under special circumstances.

ANTHROPOLOGY

Professors
Charles A. Reed, Acting Head of the Department

Associate Professors
Laura A. Bohannan, Robert L. Hall, Jack Prost, William A. Shack

Assistant Professors
Constance Cronin, Susan T. Freeman, Merwyn S. Garbarino

The department offers a program leading to the degree of Master of Arts.

Admission Requirements

Applicants must have a baccalaureate degree from an accredited college or university and must meet the requirements for admission to the Graduate College. Under ordinary circumstances, they must have a grade-point average of 4.00 (A=5.00) for the last 90 quarter hours of undergraduate study and a rank above the 70th percentile on the Graduate Record Examination verbal and quantitative tests. Students entering without an adequate background in anthropology will be expected to make up deficiencies before formal admission to candidacy is granted.

Degree Requirements

A minimum of 48 quarter hours is required for the Master's degree. All candidates must complete the course work outlined below, pass a comprehensive examination, and submit a thesis. Students engaged in specialized thesis research which demands a reading knowledge of a foreign language or a working knowledge of statistics will be expected to demonstrate satisfactory comprehension of the relevant language or skill. Foreign students must have adequate facility in the English language.

Students are required to complete a minimum of 36 quarter hours of study before admission to the comprehensive examination for the M.A. in anthropology. The distribution of graduate courses is:

12 quarter hours in Anthropology 400, 430, 450, Theory
and Method in Anthropology;
16 quarter hours in advanced courses in anthropology or
related fields, e.g., sociology, political science,
psychology, or history;
a minimum of one seminar in the anthropological field of
specialization;
no more than 12 hours in Anthropology 499, Thesis Research.

After three quarters of residence a candidate ordinarily is expected to pass a comprehensive examination covering the following fields of anthropology: theory and method in social and cultural anthropology; physical anthropology; archaeology; ethnology of one culture area, such as North America, Meso-America, Africa, or Mediterranean Europe.

Courses for Graduate Students

400. **Theory and Method in Social Anthropology. 4 hours.** Survey of contemporary and historical approaches to problems of field and library research. Prerequisite: Consent of the instructor.

410. **Advanced Study of Kinship. 4 hours.** Investigation of patrilineal, matrilineal, and bilateral kinship systems; the correlations between kinship systems and social structure; the relationships of ecological factors and kinship organization to rural and urban communities. Reading and research on special problems of kinship, marriage, residence, inheritance, authority patterns, and change. Prerequisite: Consent of the instructor.

414. **Psychological Anthropology. 4 hours.** Advanced work on the relationships between the psyche, culture, and society; special reference to cross-cultural investigations. Problems of methodology. Prerequisite: Consent of the instructor.

427. **Political Anthropology. 4 hours.** Problems in analysis and description of non-Western political systems and their articulation into modern state systems. The relationship of

the levels of political complexity to theories of political behavior. Prerequisite: Consent of the instructor.

430. **Theory and Method in Physical Anthropology.** 4 hours. Genetics and selection as correlated with the adaptive radiation of the primates, particularly the biological, environmental, and cultural factors associated with the evolution of man. Prerequisite: Consent of the instructor.

450. **Theory and Method in Prehistory.** 4 hours. Aims and methods of archaeological reconstruction; particular attention to paleoecology, the interpretation of archaeological findings in social terms, and the application of scientific knowledge from other fields to archaeological problems. Prerequisite: Consent of the instructor.

490. **Seminar on Comparative Social Institutions in Western and Non-Western Societies.** 4 hours. May be repeated twice for credit. Each seminar will select for intensive study a single problem relating to such social institutions as social stratification, political organization, warfare, or religion. Prerequisite: Consent of the instructor.

491. **Seminar in Ethnology.** 4 hours. May be repeated twice for credit. Advanced seminar in the analysis of ethnological data, focusing on the interpretation of field data from selected geographic regions and on correlated theoretical problems. Prerequisite: Anth. 400.

492. **Readings in the Ethnography of Ethiopia.** 4 hours. For advanced students in social anthropology. May be repeated twice for credit. Guided study in the social anthropology of Ethiopian tribal societies; special consideration of the central Ethiopians, western Cushites, the pastoral complex, tribes of the Rift Valley lakes. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.

495. **Developmental Sources of Anthropological Theory.** 4 hours. Seminar on the sources relevant to the current and historical development of anthropological theory primarily as deriving from interaction among the subfields of anthropology but also as these influence, and are influenced by, other disciplines. Prerequisites: Anth. 400; and 414, 430, or 450.

499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Prerequisite: Consent of the student's adviser.

Courses for Graduate and Advanced Undergraduate Students

310. **Peasant Societies.** 4 hours. Research and reading in the comparative study of peasant societies in diverse regions of the world; special emphasis, during lecture and discussion, on a critical review of the anthropological literature delineating a peasant stratum of social organization and defining its characteristics. Prerequisite: 8 hours of social anthropology, or 8 hours of sociology, and consent of the instructor.

311. **Cultural Problems in Urbanization.** 4 hours. The processes of urbanization and of cultural and societal adjustments to urban life; case studies illustrate the variety of adjustments to urban life. Prerequisite: Anth. 213.

314. **Kinship, Family, and Household. 4 hours.** Comparative study of the institutions of marriage, family, and household; the extension of kinship norms and values to other aspects of culture and society. Prerequisite: Anth. 213.

315. **Comparative Religious Movements. 4 hours.** Analysis of religious behavior; special reference to the emergence of messianic cults in Africa, Melanesia, among North American Indians and New World Negroes. Prerequisite: 8 hours of social anthropology, or 8 hours of sociology, and consent of the instructor.

316. **Economic Life of Primitive Peoples. 4 hours.** Patterns of production, distribution, and consumption in non-Western cultures. Cultural variation in attitudes toward labor, concepts of property, prestige, and wealth. Prerequisite: 8 hours of social anthropology, including one 200-level course.

317. **The Cross-Cultural Study of Social Control. 4 hours.** Cultural-jural structures in non-Western societies; modes of dispute settlement, nature and range of sanctions, and processes of social control. Prerequisite: Anth. 160

321. **Cultural Evolution. 4 hours.** Critical review of theories; examination of ethnographic materials and data on cultural change and cultural contact for the purpose of examining the mechanisms of change. Prerequisite: Anth. 213.

322. **Comparative Methods in Social Anthropology. 4 hours.** Introduction to the several kinds of comparative method, including field work, small-sample and large-sample studies. Prerequisites: Anth. 213 and Soc. 185 or the equivalents.

327. **Primitive Political Systems. 4 hours.** Examination of data and theory pertinent to non-Western political systems, a cross-cultural study of political behavior. Prerequisite: Anth. 213.

331. **Human Evolution. 4 hours.** Same as Biological Sciences 331. The phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or BioS. 282 or 318.

350. **Prehistoric Archaeology. 4 hours.** Archaeological field techniques and principles of the study of prehistory. Case studies from selected areas of the Old and New Worlds. Prerequisite: Anth. 251 or 253.

351. **Prehistory of the Near East. 4 hours.** Consideration of southwestern Asia and northeastern Africa as the core area in which the first civilizations emerged. Emphasis on the late Quaternary to about 5000 B.C.; the interrelationships between changing environment, human ecology, and cultural evolution. Prerequisite: Anth. 251 or consent of the instructor for qualified students from other departments.

352. **Early Civilization of the Old World. 4 hours.** Early civilization and incipient urbanization in Eurasia and Africa, focusing on the development of urban centers and archaic states; attention to preconditioning factors in the post-Pleistocene, Mesolithic, and Neolithic Ages. Prerequisite: Anth. 251 or 351.

355. **Field Problems in Archaeology. 6 to 12 hours.** Application of advanced techniques to the solution of special problems of archaeological field investigations; laboratory

analysis under field conditions at an off-campus location. Prerequisite: Anth. 253 or 255, and consent of the instructor.

361. **Problems in Meso-American Ethnology. 4 hours.** Intensive investigation of selected problems from the Meso-American area; special emphasis upon religion, economics, and social organization. Prerequisites: Anth. 261 and a reading knowledge of Spanish.

362. **Problems in African Ethnology. 4 hours.** Survey of the indigenous cultures of Africa; native cultures as reconstructed coterminous with their early historical contacts with the Western world; some additional data on present-day African cultures. Prerequisite: Anth. 263.

363. **Urban Cultures of Africa. 4 hours.** The indigenous urban centers of sub-Saharan Africa and the multicultural and multiracial metropolitan areas of colonial and contemporary Africa; special reference to the processes of segregation and detribalization. Prerequisite: Anth. 263 or 362.

364. **Problems in North American Ethnology. 4 hours.** Intensive reading and research focusing on special problems of religious, economic, and social systems of New World native peoples. Prerequisite: Anth. 264.

365. **Problems in Pacific Ethnology. 4 hours.** Ethnological survey of the indigenous peoples of Micronesia, Polynesia, Melanesia, and Australia; special emphasis on the social, economic, and religious life of representative groups. Prerequisite: 8 hours of social anthropology.

368. **Problems in European Ethnology. 4 hours.** Advanced reading and research in the ethnology of rural Europe; study in depth of selected case materials. Emphasis on community structure, kinship, religious and economic systems, and methods of social control; research techniques and the nature of source materials. Prerequisite: Anth. 213.

399. **Independent Study. 2 to 12 hours.** May be repeated for credit. Independent study under the supervision of a staff member. Prerequisite: Approval of the department.

BIOLOGICAL SCIENCES

John O. Corliss, Head of the Department (on leave 1969-1970)
Elmer B. Hadley, Acting Head (1969-1970)
Theodore J. Starr, Associate Head

Professors
John O. Corliss, Sidney F. Glassman, Bernard Greenberg, Helene N. Guttman, Ellis B. Little, Kenneth M. Madison, Albert S. Rouffa, William Sangster, Max C. Shank, Rolf Singer (Visiting), Eliot B. Spiess, Theodore J. Starr

Associate Professors

David Bardack, Howard E. Buhse, Jr., Donald A. Eggert, Elmer B. Hadley, Darrel L. Murray, Halina J. Presley, David Shomay, Charles N. Spirakis, Thomas N. Taylor, Robert B. Willey

Assistant Professors

Louise Anderson, James A. Bond, Manuel Goldman, John A. Nicolette, Phebe VanValen, Ruth L. Willey

Instructors

Harold W. Kerster

The Department of Biological Sciences offers work leading to the degree of Master of Science in the following areas of specialization: genetics and development; systematics, evolution, and ecology; and physiology and morphology.

Admission Requirements

Grade-Point Average: At least 3.75 (A=5.00) for the last 90 quarter hours of undergraduate study. A student whose average is between 3.50 and 3.75 may petition for consideration.

Hours: 30 quarter hours in biological sciences excluding 100-level courses and including genetics and cellular, or general, physiology or the equivalent; one year in each of the following: chemistry (including organic), mathematics, and physics. Deficiencies must be made up early in the student's residence.

Degree Requirements

Hours: 48 quarter hours of approved graduate work of which at least 18 must be in 400-level courses.

Thesis: Candidates must submit an acceptable thesis and pass a comprehensive final examination. A maximum of 16 quarter hours in Biological Sciences 499, Thesis Research, may be credited. Candidates whose interests lie in secondary education may be exempted from the thesis requirement at the option of the department. In lieu of the thesis, they will substitute satisfactory performance on the oral comprehensive examination and 4 to 12 quarter hours of Biological Sciences 493, Problems in Modern Biology.

Comprehensive Examination: Oral; the candidate must demonstrate competence in two of the three areas of specialization and familiarity (satisfiable by A

or B grades in approved courses) with the third. Candidates electing a thesis must take an oral examination, administered by a committee including members of his advisory committee, which tests the candidate on his general biological knowledge and on the purpose and content of his thesis.

Degree candidates are urged to achieve competence in at least one modern foreign language and to register for courses in calculus, statistics, and biochemistry.

Courses for Graduate Students

401.   **Foundations of Biological Thought. 4 hours.** Presentation and analysis of some of the fundamental concepts of the mainstreams of biological thought.

402.   **Patterns of Biological Enquiry. 4 hours.** Contemporary and developing ideas in biology, utilizing blocks of integrated research papers to analyze the functioning of selected ideas as they influence the design, execution, and interpretation of research problems. Prerequisite: BioS. 401.

403.   **Enquiry Processes in the Classroom. 4 hours.** The insights derived from Biological Sciences 401 and 402 are used in preparing inquiry-oriented materials for presentation in the classroom. Prerequisite: BioS. 402.

404.   **Methods in Cellular Physiology I. 2 to 5 hours.** Analytical techniques and instrumentation used in microbiology, cell biology, and physiology. Practical and theoretical problems associated with these techniques will be considered. Prerequisites: Cellular biodynamics or equivalent, and biochemistry or concurrent registration in biochemistry.

406.   **Biological Ultrastructure. 5 hours.** Discussion, instrumentation, and special topics in fine structure of plant and animal cells and cell products. Prerequisites: BioS. 261, 309, organic chemistry, and consent of the instructor.

407.   **Principles of Cell and Tissue Culture. 5 hours.** Methods for primary isolation of plant and animal tissue and subsequent cultivation. Uses of cells in culture as experimental tools. Prerequisites: BioS. 250 and 261.

408.   **Histochemistry. 5 hours.** Analysis of cell and tissue structure by histochemical methods. Prerequisites: BioS. 261, 309, Chem. 234, and consent of the instructor.

411.   **Discussions in Paleobiology. 1 hour.** May be repeated for credit. Consideration of selected topics and current research literature in paleobiology. Prerequisite: Consent of the instructor.

413.   **Problems in Evolutionary Paleontology. 4 hours.** Same as Geological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change such as rates of evolution, population structure and extinction as shown by the vertebrate fossil record. Prerequisites: BioS. 218 and 305. BioS. 345 is recommended.

415. **Principles of Morphogenesis. 4 hours.** Analysis of factors controlling growth and differentiation in unicellular and multicellular organisms. Prerequisites: BioS. 240 and 313.

416. **Evolution of Pteridophytes. 4 hours.** Basic structure and major features of evolution of lycopods, sphenopsids, and ferns. Prerequisite: BioS. 333 or the equivalent, and consent of the instructor.

417. **Evolution of Gymnosperms. 4 hours.** Basic structure and major features of evolution of naked seeded plants. Prerequisite: BioS. 333 or the equivalent, and consent of the instructor.

418. **Angiosperm Morphology. 4 hours.** Basic structure and major features of evolution within the flowering plants. Prerequisite: BioS. 333 or the equivalent, and consent of the instructor.

419. **Topics in the Morphology and Evolution of Plants. 1 hour.** Seminar. Prerequisites: BioS. 333 or the equivalent; 416, 417, or 418, and consent of the instructor.

420. **Advanced Vertebrate Paleontology. 4 hours.** Same as Geological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups: fishes, amphibians and reptiles, mammals. Prerequisites: BioS. 282 and 318.

422. **Physiological Ecology of Plants. 4 hours.** Physiological investigation of climatic and edaphic differentiation; emphasis on the ecophysiological adaptations of species to their environments. Prerequisites: BioS. 315, 324, or 380, and one quarter of plant physiology.

423. **Discussions in Ecology and Behavior. 2 hours.** May be repeated for credit up to 8 hours. Consideration of selected topics, current literature, and recent advances in ecology and behavior. Prerequisite: Consent of the instructor.

424. **Advanced Paleobotany. 4 hours.** Problems in the structure and phylogeny of representative fossil plant groups. Lecture, laboratory, occasional field trip. Prerequisite: BioS. 319.

425. **Plant Anatomy. 4 hours.** Examination of the internal structure of vascular plants; emphasis on structure and function. Lecture and laboratory. Prerequisite: Consent of the instructor.

426. **Biochemical Systematics. 4 hours.** Analysis of the utilization of comparative biochemical data in determining evolutionary relationships among groups of plants and animals. Prerequisites: BioS. 345 and 353.

427. **Advanced Taxonomy of Flowering Plants. 4 hours.** Emphasis on theories and data for evolution within groups of flowering plants. Prerequisite: BioS. 345 and consent of the instructor.

438. **Experimental Plant Systematics. 4 hours.** Evolutionary mechanisms and pathways in higher plants; analysis of genetic, chromosomal, morphological, and physiological

properties of natural assemblages at and below the species level of divergence. Lecture and laboratory. Prerequisites: BioS. 342 and 349.

440. **Seminar in Genetics. 2 hours.** Discussion of research literature in the field. Student topics assigned. Prerequisite: BioS. 240 and consent of the instructor.

442. **Problems in Population Genetics 3 hours.** Lecture and discussion of research literature in the field. Prerequisites: BioS. 343 and 344.

445. **Discussions in Systematics and Evolution. 1 hour.** May be repeated for credit. Consideration of current literature and of recent advances in the field of systematic biology. Prerequisite: Consent of the instructor.

450. **Topics in Microbial Physiology. 4 hours.** Modern contributions to microbiology, including the ultrastructure of the bacterial cell, metabolism and control mechanisms, bacterial genetics and cell-viral systems. Lecture and laboratory. Prerequisite: BioS. 350.

451. **Insect Microbiology. 5 hours.** Host microbe associations and their commensal, pathogenic, and other interactions. Virus, protozoan, and bacterial associations. Prerequisites: BioS. 250 and 388.

452. **Insect Physiology. 5 hours.** Structure, function, and adaptive aspects of the insect exoskeleton and organ systems; growth, differentiation, and reproduction. Prerequisite: BioS. 388.

455. **Topics in Molecular Biology. 3 hours.** May be repeated for credit. Selected topics emphasizing molecular studies involved in such diverse biological areas as virology, genetics, immunology, photobiology, pharmacology, exobiology. Prerequisites: BioS. 240, 250, 261, and consent of the instructor.

470. **Comparative Animal Physiology I. 4 hours.** Selected adaptive mechanisms of animals to the stresses of the environment in their several major kinds of habitat. Emphasis on invertebrates. Lecture, laboratory, discussion. Prerequisites: BioS. 363 and 364.

471. **Comparative Animal Physiology II. 4 hours.** Selected adaptive mechanisms of animals to the stresses of the environment in their major kinds of habitat. Emphasis on invertebrates. Lecture, laboratory, discussion. Prerequisite: BioS. 470.

472. **Experimental Animal Physiology. 4 hours.** May be repeated once for credit. Selected topics in experimental surgery and pharmacodynamics. Prerequisite: BioS. 363 or 364.

486. **Advanced Invertebrate Zoology. 4 hours.** Selected topics in currently advancing areas of descriptive and experimental invertebrate zoology. Emphasis on recent comparative research in such areas as behavior, embryogenesis, circadian rhythms, and ecological adaptations. Lecture and laboratory. Prerequiste: BioS. 385 or 470 and consent of the instructor.

489. **Advanced Protozoology. 4 hours.** Consideration of selected topics in modern protozoological research. Prerequisite: BioS. 389.

490. **Problems in Vertebrate Morphology. 4 hours.** Feeding and locomotory mechanisms of selected vertebrates. Dissection, experimentation, and seminar presentation of analyzed results. Laboratory and discussion. Prerequisite: BioS. 393 or the equivalent.

493. **Problems in Modern Biology. 2 to 4 hours.** May be repeated for credit. Not to be used for thesis research. Guided study of selected topics with research potential in specific fields of advanced modern biology. Prerequisite: Consent of the instructor.

495. **Graduate Seminar. No credit.** Thesis presentation by advanced students; occasional seminar by staff and invited speakers. Required of graduate students every quarter.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Work in a number of fields offered under the direction of faculty members with appropriate graduate standing.

Courses for Graduate and Advanced Undergraduate Students

300. **Seminar. 0 to 1 hour.** Faculty and visiting biologists discuss results of their research programs before staff and students at weekly meetings. Attendance of majors at all meetings is strongly encouraged.

304. **Instrumentation in Cell and Tissue Study. 3 hours.** Advanced cytology; emphasis on instrumental methods. Modern biophysical techniques. Prerequisites: BioS. 261, Chem. 134, Phys. 102, and concurrent registration in BioS. 309.

307. **Biological Methods for Teachers. 3 hours.** Investigation of methodological subject matter, conducted primarily as a practicum; emphasis on the development of competencies. Prerequisite: 40 hours of biological sciences.

309. **Cytology. 3 hours.** Structure and function of cells as revealed through historical development and modern research techniques. Lecture.

313. **Developmental Biology. 4 hours.** Principles governing growth and differentiation at molecular, fine structural, cellular, and organismic levels. Lecture and laboratory.

315. **Principles of Ecology. 3 hours.** Composition and distribution of biotic communities, plant and animal; emphasis on the interplay of physical and biological factors of the environment. Prerequisite: Concurrent registration in BioS. 324 or 380.

316. **Invertebrate Paleontology. 4 hours.** Same as Geological Sciences 316. Phylogeny morphology, and ecology of the fossil invertebrates. Prerequisite: BioS. 218 and consent of the instructor.

318. **Vertebrate Paleontology. 4 hours.** Same as Geological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisite: Consent of the instructor.

319. **Paleobotany. 5 hours.** Same as Geological Sciences 319. Structure, phylogeny, and

stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.

320. **Field Botany. 5 hours.** Flora of the Chicago region. Lecture, laboratory, field trips. Prerequisite: BioS. 220 or the equivalent.

321. **Plant Geography of North America. 4 hours.** Ecological and systematic treatment of vegetation regions and principal subdivisions; emphasis on environmental factors and species composition. Prerequisite: BioS. 220 or 315.

324. **Plant Ecology Laboratory. 2 hours.** Special attention to vegetation and environment of the Chicago region. Laboratory and field trips. Prerequisite: Concurrent registration in BioS. 315.

328. **Plant Physiology I. 5 hours.** Plant relations to water and solutes; translocation; inorganic plant nutrition; photosynthesis; respiration. Lecture and laboratory.

329. **Plant Physiology II. 5 hours.** Intensive study of the metabolism of carbon and nitrogen compounds and the physiology of growth and development. Lecture and laboratory. Prerequisite: BioS. 328.

331. **Human Evolution. 4 hours.** Same as Anthropology 331. Phylogeny of the primate order and the problems of speciation; particular emphasis on the relative roles of culture and nature as selective forces in human evolution. Prerequisite: Anth. 230 or BioS. 282 or 318.

333. **Morphology of Vascular Plants. 4 hours.** Structure, reproduction, and evolutionary history of representative vascular plants, including psilopsids, lucopsids, sphenopsids, ferns, gymnosperms, and angiosperms. Lecture and laboratory.

342. **Cytogenetics. 4 hours.** Chromosomal phenomena involved in the mechanics of genetics, structure of genetic material, and the role chromosomal variation plays in the evolution of races and species. Lecture and laboratory. Prerequisite: BioS. 240.

343. **Population Genetics. 3 hours.** Genetic dynamics for animal, plant, and human populations: mating systems, selection, sampling, and mutation. Lecture and recitation. Prerequisites: BioS. 240, Math. 130, and credit or concurrent registration in statistics.

344. **Experimental Population Genetics. 3 hours.** Discussion of experimental and field empirical studies estimating genetic parameters, influence of selection, and other evolutionary forces on genotypes in populations. Lecture, laboratory, and discussion. Prerequisite: BioS. 343.

345. **Systematics and Evolution. 3 hours.** Consideration of principles and interrelationships; basic analysis of evolutionary mechanisms; rationale for classification systems; nature of taxonomic characters. Lecture and discussion. Prerequisite: BioS. 240.

347. **Physiological Genetics. 5 hours.** Consideration of heredity at the biochemical level; particular reference to gene duplication, mutation, genetic control of protein synthesis, and genetic regulatory mechanisms. Lecture and laboratory. Prerequisites: BioS. 240 and Chem. 350.

349. **Evolutionary Theory.** 3 hours. Analysis of evolutionary mechanisms in plants and animals; variation and differentiation in populations and species; origins of super-specific taxa. Prerequisites: BioS. 240, 315, and 345.

350. **Advanced Microbiology.** 5 hours. Modern contributions to the cellular anatomy, physiology, and genetics of microorganisms. Lecture and laboratory. Prerequisites: BioS. 250 or 261, and credit or registration in biochemistry. Calculus is strongly recommended.

351. **Virology.** 3 hours. Nature of viruses and their morphology, chemical composition, assay, host-parasite interaction, and life cycles. Prerequisites: BioS. 261 and 350, Chem. 235 and 350, or the equivalents.

353. **Chemical Biogenesis.** 3 hours. Same as Chemistry 353. Biosynthesis of important biological compounds. Lecture and discussion. Prerequisite: Chem. 134 or 234.

356. **Mycology.** 4 hours. Analysis of the morphology, physiology, and genetics of fungi as related to the taxonomy and phylogeny of fungi. Lecture and laboratory.

359. **Neuroanatomy.** 3 hours. Introduction to the central nervous system using a programmed text and supplementary material in the form of visual aids and outside readings. Prerequisite: One year of biological sciences.

361. **Macromolecules of Biological Importance.** 5 hours. Nucleic acids and proteins; emphasis on their roles in the replication of genetic material. Lecture and laboratory. Prerequisite: A course in organic chemistry and consent of the instructor.

363. **Animal Physiology I.** 5 hours. The role of the digestive, circulatory, respiratory, and osmoexcretory systems in the maintenance of organismic homeostasis. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.

364. **Animal Physiology II.** 5 hours. The role of the muscular, sensory, nervous, and endocrine systems in the maintenance of organismic integration. Emphasis on vertebrates. Lecture and laboratory. Prerequisite: BioS. 261.

377. **Endocrinology.** 5 hours. Animal hormones in the control of integration, homeostasis, growth, and development. Lecture and laboratory. Prerequisite: BioS. 364.

380. **Animal Ecology Laboratory.** 2 hours. Population and community assemblages of the Chicago region. Laboratory and field trips. Prerequisite: Concurrent registration in BioS. 315.

382. **Environmental Conservation.** 3 hours. Applied ecology of the use of renewable natural resources; special emphasis on biotic problems of land, water, and air management; pollution, population increase, multiple-use concept, and land ethics. Lecture and field trips. Prerequisites: BioS. 315, and 324 or 380.

384. **Invertebrate Zoology I.** 5 hours. Comparative study of structure, development, behavior, classification, and evolution of the lower invertebrate groups. Lecture and laboratory.

385. **Invertebrate Zoology II.** 5 hours. Comparative study of structure, development,

classification, and evolution of the higher invertebrate groups exclusive of arthropods. Lecture and laboratory. Prerequisite: BioS. 384.

388. **General Entomology. 5 hours.** Introduction to the morphology, physiology, classification, behavior, and evolution of insects. Lecture and laboratory.

389. **Principles of Protozoology. 5 hours.** Introduction to the comparative morphology, physiology, and systematics of the protozoa, including discussion of advances in major areas of current research. Lecture and laboratory.

393. **Functional Animal Morphology. 4 hours.** Functional analysis of selected invertebrate and vertebrate organ systems applied to problems of comparative structure, adaptation, and phylogeny. Lecture and laboratory.

395. **Zoogeography. 3 hours.** Examination of present and past distribution of animals; emphasis on physiographic and ecologic factors which affect the development of faunal regions. Stress on experimental methods to elucidate mechanisms of origin and diversification of island and continental faunas.

397. **Biology of Lower Vertebrates. 4 hours.** Experimental and descriptive studies on fishes, amphibians, and reptiles; emphasis on ecology, speciation, and adaptive radiation. Lecture, laboratory, and field trips. Prerequisite: BioS. 218, 240, or 280.

CHEMISTRY

Professors
William F. Sager, Head of the Department; Bernard J. Babler, Joseph H. Boyer, Roy Huitema (emeritus), Chui F. Liu, Robert M. Moriarty, Jan Rocek, Robert I. Walter

Associate Professors
Thomas H. Brown, Richard L. Carlin, Charles K. Hunt, Jacques Kagan, J. Victor Mansfield, Samuel Schrage

Assistant Professors
Benedict W. Bangerter, Ronald J. Baumgarten, Richard P. Burns, Cynthia J. Jameson, Rosalind A. Klaas, Florence C. Klee, Leonard Kotin, Yecheskel Rasiel, Tsu-chia Shieh, John J. Steiner, Milton Yusem, Robert F. Zahrobsky

Instructors
Elaine Z. Herzog

Work toward the Master of Science and Doctor of Philosophy degrees is offered in inorganic, organic, and physical chemistry.

Admission Requirements

Applicants must have fulfilled the usual course requirements leading to a Bachelor's degree with a major in chemistry and must have a 4.00 grade-point average in mathematics and science courses. Students with lower averages may apply and will be considered on an individual basis. Applicants who have majored in fields other than chemistry may be admitted to graduate study in chemistry on an individual basis.

Degree Requirements

Master of Science

Hours: 48 quarter hours, of which 32 must be within the Department of Chemistry. The remaining 16 hours may be selected from the offerings of other departments on the basis of their relevance to a particular area of interest. Course work in other departments will be strongly recommended when it is judged advisable for the student's best professional development. At least 16 quarter hours must be taken at the 400 level, of which 12 must be selected from the course offerings of the Department of Chemistry.

All M.S. degree candidates are required to participate in undergraduate teaching which will be assigned in individual cases according to background and interest. A minimum of 16 quarter hours is required.

Thesis: Optional; up to 18 quarter hours of thesis research may be credited, subject to the approval of the department.

Doctor of Philosophy

In addition to satisfying the general requirements of the Graduate College, students must pass a set of departmental cumulative examinations. The only specific courses required of all candidates are Chemistry 404, 405, and 406, which represent a foundation for all areas of specialization. All other formal course work is determined, with the advice of the department, according to its relevance to the student's field of interest.

All Ph.D. candidates are required to participate in undergraduate teaching which will be assigned in individual cases according to background and interest. A minimum of 16 quarter hours is required.

Thesis: Candidates must prepare a thesis based upon original research carried out under the direction of a qualified member of the department and approved by an examination committee.

All candidates must meet the departmental foreign language requirement.

Prospective candidates may obtain detailed information concerning all requirements by applying to the Department of Chemistry.

Courses for Graduate Students

404. Quantum Mechanics. 4 hours. Exact solution of the Schrodinger equation for simple systems; variational principle; approximation methods in complex systems; effects of electric and magnetic fields. Required of all Ph.D. students in chemistry.

405. Molecular Spectroscopy. 4 hours. Analysis and interpretation of molecular spectra, including electronic, vibrational, magnetic resonance and Mossbauer spectra. Required of all Ph.D. students in chemistry.

406. Chemical Applications of Group Theory. 4 hours. Introduction to the use of group-theoretical methods in the analysis of spectroscopic problems; ligand and crystal field theory; molecular orbital calculations. Required of all Ph.D. students in chemistry. Prerequisite: Chem. 405.

412. Special Topics in Inorganic Chemistry. 2 to 4 hours. Lectures on topics not represented in regularly scheduled courses.

413. Physical Methods of Inorganic Chemistry. 3 hours. Application of physicochemical methods to problems in inorganic chemistry.

414. Advanced Inorganic Laboratory. 2 to 4 hours. Experimental methods in synthesis and study of inorganic compounds.

415. Complex Inorganic Compounds. 4 hours. Stereochemistry, reactions, and theory of bonding of coordination compounds.

432. Special Topics in Organic Chemistry. 4 hours. Discussion of topics of current interest.

433. Special Topics in Reaction Mechanisms. 4 hours. Theory and techniques in specialized areas in reaction mechanisms. Prerequisite: Chem. 362 or the equivalent.

434. Physical Methods in Organic Chemistry. 4 hours. Application of infrared, ultraviolet-visible, magnetic resonance, electron spin resonance, and mass spectrometry and optical rotatory dispersion in organic chemistry. Prerequisite: Chem. 405.

435. Advanced Organic Synthesis. 4 hours. Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Credit or registration in Chem. 434.

436. Chemistry of Natural Products I. 4 hours. Discussion of the more important groups of natural products, including their structure determination, synthesis, and biogenetical relationships. Offered alternate years. Prerequisite: Chem. 235.

442. Special Topics in Physical Chemistry. 2 to 4 hours. Lectures and reading in areas not normally treated in standard courses. Discussions of topics of current interest.

443. **Special Topics in Chemical Kinetics. 2 to 4 hours.** Theory and techniques in specialized areas of chemical kinetics. Prerequisite: Chem. 349 or the equivalent.

444. **Statistical Mechanics I. 4 hours.** Statistical models of systems in thermodynamic equilibrium. Offered alternate years. Prerequisite: Chem. 349.

445. **Statistical Mechanics II. 4 hours.** Statistical models of the liquid state and nonequilibrium processes. Prerequisite: Chem. 444.

446. **Quantum Chemistry I. 4 hours.** Treatment of complex atoms and molecular systems. Hartree-Foch calculations and other methods; interaction of radiation matter. Prerequisite: Chem. 406.

447. **Quantum Chemistry II. 4 hours.** Continues Chemistry 446. Prerequisite: Chem. 446.

448. **Quantum Chemistry III. 4 hours.** Continues Chemistry 447. Prerequisite: Chem. 447.

461. **Synthetic Methods of Organic Chemistry I. 4 hours.** Discussion of methods used in organic syntheses; introduction and modification of functional groups, methods of selective group protection, stereospecific processes, recent examples of applications. Prerequisite: One year of organic chemistry.

462. **Synthetic Methods of Organic Chemistry II. 4 hours.** Continues Chemistry 461. Prerequisite: Chem. 461.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Prerequisite: Approval of the department.

Courses for Graduate and Advanced Undergraduate Students

315. **Inorganic Chemistry. 4 hours.** Lectures and assigned readings in structural inorganic chemistry, inorganic reaction mechanisms and techniques, and the nature of the coordinate bond. Prerequisite: Chem. 342 or the equivalent.

321. **Chemical and Instrumental Analysis I. 4 hours.** Chemical and instrumental methods of analysis and their application to the quantitative study of chemical reactions. Prerequisites: Chem. 235 and credit or registration in Chem. 343, or the equivalents.

322. **Chemical and Instrumental Analysis II. 3 hours.** Continues Chemistry 321. Prerequisite: Chem. 321.

338. **Systematic Identification of Organic Compounds. 3 hours.** Primarily a laboratory course; chemical, physical, and spectroscopic methods are used to separate, purify, and identify organic compounds. Prerequisite: Chem. 237.

339. **Organic Synthesis. 2 to 4 hours.** Discussion and laboratory work involving special techniques in organic synthesis. Prerequisite: Chem. 237 or the equivalent.

340. **Physical Chemistry I. 3 hours.** Credit is not given for both the Chemistry 380-382 sequence and the 340-342-344 sequence. Introduction to the study of chemical

principles. Prerequisites: Chem. 119 or 121, credit or registration in Math 133, and one year of college physics.

342.   **Physical Chemistry II. 3 hours.** Continues Chemistry 340. Prerequisite: Chem. 340.

344.   **Physical Chemistry III. 3 hours.** Continues Chemistry 342. Prerequisite: Chem. 342.

347.   **Introduction to Quantum Chemistry. 4 hours.** Applications of quantum mechanics to problems of chemical interest. Additional assignments required. Prerequisite: Chem. 344.

348.   **Thermodynamics. 4 hours.** Lectures and assigned readings; applications to chemical systems. Prerequisite: Chem. 344.

349.   **Statistical Thermodynamics. 4 hours.** Introduction to statistical mechanics and application to equilibrium thermodynamics. Prerequisite: Chem. 344.

350.   **General Biochemistry I. 3 hours.** Chemistry of biological systems, including enzymes, vitamins, nucleic acids, carbohydrates, and proteins. Prerequisites: Chem. 119 or 121, and 134 or 234.

351.   **General Biochemistry II. 3 hours.** Continues Chemistry 350. Prerequisite: Chem. 350.

353.   **Chemical Biogenesis. 3 hours.** Same as Biological Sciences 353. Biosynthesis of important biological compounds. Prerequisite: Chem. 134 or 234.

355.   **Biochemistry Laboratory I. 2 hours.** Introduction to experimentation with biochemical systems, processes, and compounds of biochemical importance. Prerequisite: Registration in Chem. 350.

357.   **Biochemistry Laboratory II. 2 hours.** Continues Chemistry 355. Prerequisites: Chem. 355 and registration in Chem. 351.

361.   **Advanced Organic Chemistry I. 4 hours.** A physical-organic approach to organic reactions with particular emphasis on reaction mechanisms and the relationship between reactivity and structure. Lectures and assigned readings. Prerequisites: Chem. 235 and 344.

362.   **Advanced Organic Chemistry II. 4 hours.** Continues Chemistry 361. Lectures and assigned readings. Prerequisite: Chem. 361.

380.   **Principles of Physical Chemistry I. 3 hours.** Credit is not given for both the Chemistry 380-382 sequence and the 340-342-344 sequence. Chemistry 380 and 382 provide an elementary introduction to physical chemistry; particular emphasis on topics of importance in the biological and health sciences. Prerequisites: Chem. 119 or 121, calculus, and two quarters of physics.

382.   **Principles of Physical Chemistry II. 3 hours.** Continues Chemistry 380. Prerequisite: Chem. 380.

383.   **Elementary Physical Chemistry Laboratory. 1 hour.** An introductory course. Prerequisite: Chem. 380.

384. **Surface and Macromolecular Chemistry.** 3 hours. Interfacial phenomena, stability of disperse systems, properties of polymer solutions. Prerequisite: Chem. 382 or the equivalent and consent of the instructor.

385. **Surface and Macromolecular Laboratory.** 2 hours. Techniques in surface and macromolecular chemistry. Prerequisite: Credit or registration in Chem. 384 and consent of the instructor.

399. **Independent Study.** 3 hours or more. May be repeated for credit. Supervised study in an area not represented by regularly offered courses. Prerequisite: Written approval of the department.

ENERGY ENGINEERING

Professors
James P. Hartnett, Head of the Department; Paul M. Chung, Henry L. Garabedian, Norman A. Parker, Satish C. Saxena

Associate Professors
Joseph C. F. Chow, Chaim Gutfinger, David S. Hacker, John H. Kiefer, Wolodymyr J. Minkowycz, Harold A. Simon, Stephen Szepe

Assistant Professors
Aemer D. Anderson, Allen C. Cogley, Edward S. Pierson, Kenneth L. Uherka, Calvin J. Wolf

The department offers a program leading to the degree of Master of Science in Energy Engineering and, jointly with the Department of Materials Engineering, a program leading to the degree of Doctor of Philosophy in Engineering (Solids and Fluids).

These programs are broadly based to accommodate students in aerospace, chemical, mechanical, power engineering, and related fields. The primary areas upon which these fields are based are continuum and molecular fluid mechanics, heat and mass transfer, and macroscopic and microscopic thermodynamics.

After admission to the Graduate College, a temporary adviser is assigned to the student. The student, however, is required to choose a permanent adviser during the first quarter. As soon as the permanent adviser has been selected, the student should outline the complete program proposed for the degree (M.S. or Ph.D) with the help of his adviser and the graduate committee of the department.

The Ph.D. program presently includes the following broad areas of specialization: continuum mechanics, gas dynamics, heat transfer, metallurgy, plasma

dynamics, soil engineering, and structures. Of these, the Department of Energy Engineering offers study in the fields of gas dynamics, heat transfer, and plasma dynamics. Students are permitted and encouraged to follow interdisciplinary programs which may include more than one area of specialty and require taking courses in more than one department.

Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.00 out of 5.00) or better in undergraduate study. Those with lower averages may be admitted upon recommendation of the department, provided they satisfy the minimum requirements of the Graduate College. Practicing engineers wishing to return to school for further graduate instruction may be admitted on a tentative basis if their professional experience makes it appear likely that they will be able to follow the program successfully. This tentative admission will become permanent after the completion of at least 16 quarter hours with an average of 4.00 or better.

Degree Requirements

A grade-point average of at least 4.00 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

Master of Science

Forty-eight quarter hours are required for the degree; at least 16 of them must be in 400-level courses. A student may or may not submit a thesis, but in the event a thesis is submitted, 16 hours of Energy Engineering 499 will be credited toward the degree. If no thesis is written, the student must complete a research project under the guidance of an adviser from the department. This project will entail the submission of a report showing to the adviser's satisfaction the ability of the student to conduct research at the Master's level. Four hours of credit will be awarded upon completion of this project. In addition, the student will be required to take the qualifying examination, on which he may receive either of two grades: one is with recommendation to continue toward the doctorate and the other is without the recommendation.

If the candidate submits a thesis, he is exempt from the qualifying examination and the project; instead he must, at the completion of the thesis, defend it before an examining committee.

Doctor of Philosophy

All graduate students planning to pursue the Ph.D. are required to take the qualifying examination during the second year of their graduate study if they hold a Bachelor's degree. If the student already has a Master's degree, he must take the qualifying examination no later than the end of the first year following his arrival at the University.

A minimum of 96 hours of course work beyond the Bachelor's degree is required for the Ph.D., of which at least 32 hours must consist of 400-level courses. The total must include a major, the scope of which is to be determined by the adviser and the graduate committee of the department, and a minor of at least 24 quarter hours. Credit in two courses from the Department of Materials Engineering must be included, in addition to at least 12 quarter hours in courses offered by the Department of Mathematics, of which at least three hours must be at the 400 level.

Reading proficiency in German, French, or Russian is required. In special cases another foreign language may be substituted upon a convincing demonstration of the relevance of this language to the student's major area.

Toward the end of his course work and after satisfying the foreign language requirement, the student is required to pass a preliminary examination administered by a committee of faculty members.

A major requirement of the Ph.D. program is the completion of a thesis based on a program of original research. The research is carried out and the thesis is written under the supervision of the student's adviser. The thesis must be defended before an examining committee.

Courses for Graduate Students

401. Classical Thermodynamics. 4 hours. The postulatory approach to thermodynamics; entropy maximum postulate; conditions for equilibrium and stability. Property relations; reversibility; processes and cycles. Thermodynamics of elastic, magnetic, and electric systems. Prerequisite: Math. 220 or the equivalent.

402. Thermodynamics of Multicomponent Systems. 4 hours. Application of the first, second, and third laws to chemical engineering systems. Concepts of chemical potential and fugacity. Availability and free energy. Chemical and phase equilibria with application to multicomponent and multiphase systems. Properties near the critical point. Law of corresponding states. Problems of a chemical engineering nature. Prerequisite: EnrE. 401 or the equivalent.

404. Irreversible Thermodynamics. 4 hours. Irreversible systems approaching equilibrium. Method of irreversible thermodynamics; Onsager's fundamental theorem; statistical and kinetic bases of the theorem. Engineering applications: chemical and electrochemical reactions; thermal diffusion and diffusion thermophenomena; thermoelectric and thermomagnetic phenomena. Thermodynamic time. Prerequisite: EnrE. 401 or the equivalent.

406. **Transport Phenomena. 4 hours.** Development of classical and statistical concepts of molecular diffusivity, conductivity, and other transport parameters. Kinetic theory of gases. Partition functions. Maxwell and Boltzmann distribution functions. Prerequisite: EnrE. 305 or the equivalent.

412. **Potential Flow. 4 hours.** Fluid kinematics, fundamental equations, exact and approximate solutions of the potential equation, conformal mapping, airfoil theory, and surface waves. Prerequisite: EnrE. 212 or the equivalent.

414. **Mechanics of Viscous Fluids. 4 hours.** Internal and external flows. Boundary layer analysis. Similarity solutions, integral methods, and other techniques for treating laminar and turbulent flows. Prerequisite: EnrE. 310 or the equivalent.

416. **Compressible Fluid Mechanics. 4 hours.** Conservation equations, equations of state, surface of discontinuity, one-dimensional and two-dimensional subsonic and supersonic flows, Prandtl-Mayer expansions and shock phenomena, theory of characteristics, and Hodograph methods. Prerequisite: EnrE. 213 or the equivalent.

418. **Fundamentals of Turbulence. 4 hours.** Mathematical descriptions of turbulence field; kinematics of homogeneous turbulence; correlation and spectrum tensors; dynamic behavior of isotropic turbulence; universal equilibrium theory; nonisotropic turbulence; transport processes in turbulent flows. Prerequisites: EnrE. 414 or 422, and Math. 323 or the equivalent.

421. **Heat Conduction. 4 hours.** Analysis of heat conduction in solids, including the use of Fourier series, integral transforms, similarity transformations, and approximate methods. Prerequisite: Consent of the instructor.

422. **Convective Heat Transfer. 4 hours.** Conservation equations. Momentum, heat, and mass transfer in laminar and turbulent boundary layers for internal and external flows. Convective heat transfer at high velocities. Heat transfer with change of phase. Special topics in convective heat transfer. Prerequisite: EnrE. 310 or the equivalent.

424. **Thermal Radiation. 4 hours.** Introduction to Planck's quantum theory. Black-body radiation; Wien's law; Stephan-Boltzmann's law. Basic concepts of total and spectral emissivity, absorptivity, reflectivity, and transmissivity. Kirchhoff's law. Radiation exchange between solid surfaces; gaseous radiation; radiation-convection interaction. Prerequisite: Consent of the instructor.

426. **Radiation Gas Dynamics. 4 hours.** Basic laws and definitions of thermal radiation. Energy transfer in absorbing, emitting, and scattering media. Thin and thick approximate methods. Radiative equilibrium. Combined conduction and radiation. Combined convection and radiation. Prerequisites: EnrE. 414 or 422, and Math. 321 or the equivalent.

432. **Kinetic Theory of Nonuniform Gases. 4 hours.** Kinetic theory distribution functions, Liouville theorem and Boltzmann equation. Moments of Boltzmann equation. Near-equilibrium perturbations; nonequilibrium analyses; rarefied gas flows; shock structure; nonequilibrium plasmas. Prerequisites: EnrE. 304, 310, and Math. 322 or the equivalent.

434. **Plasma Dynamics. 4 hours.** Electromagnetic fields: motions of charged particles; statistical description of plasmas; ionization phenomena; Landau damping; electromagnetic waves; instabilities. Prerequisite: EnrE. 432.

436. **Chemically Reacting Flows. 4 hours.** Nonequilibrium states; chemical thermodynamics and kinetics. Multicomponent continuum equations for flow of nonequilibrium fluids. Inviscid nonequilibrium flows. Boundary layer flows with surface and gas-phase reactions. Frozen and equilibrium criteria. Waves in relaxing media. Prerequisites: EnrE. 414 or 422, and 416.

451. **Kinetics of Gas Reactions. 4 hours.** Basic concepts of reaction rate and mechanism. Collision theory, absolute rate theory, and theory of unimolecular decomposition. Dissociation, recombination, and chain reactions. Combustion, flames, and detonations. Catalysis. Prerequisites: EnrE. 304 and 305 and consent of the instructor.

484. **Mathematical Techniques of Nuclear Reactor Theory I. 4 hours.** Same as Mathematics 484. Introduction to nuclear physics and nuclear reactor physics; flux distributions, critical mass, slowing down kernels and their Fourier transforms, two-group steady state theory in the reflected reactor, buckling iteration method, matrix methods in boundary value and criticality problems in the one-dimensional multiregion reactor, series solutions of group diffusion equations in multiregion reactor and in two-dimensional fully reflected reactor, reactor criticality codes. Prerequisites: Math. 312 and 323; 341 or 348; 381 or the equivalent.

485. **Mathematical Techniques of Nuclear Reactor Theory II. 4 hours.** Same as Mathematics 485. Variational methods in the criticality problem, theory of control rods in cylindrical reactor, introduction to reactor kinetics, perturbation theory and applications, adjoint flux distribution, inhour equation for multiregion multifuel reactors, xenon poisoning, and override problem. Prerequisite: EnrE. 484.

486. **Mathematical Techniques of Nuclear Reactor Theory III. 4 hours.** Same as Mathematics 486. Cylindrical reactor with source, power-level determination problem, time-dependent flux distributions in multiregion reactor, one-group model, transient and stable flux distributions in multiregion reactor, two-group model, self-limiting power bursts, analysis of nonlinear feedback problems. Prerequisite: EnrE. 485.

491. **Specialized Problems. 4 to 12 hours.** Specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

493. **Current Topics of Energetics. 4 hours.** The particular topics will vary from quarter to quarter depending on the interests of the students and the specialties of the instructor teaching the course at the time. Prerequisite: Consent of the instructor.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Individual research in specialized problems under the supervision of faculty. Prerequisite: Arrangement with the faculty.

Courses for Graduate and Advanced Undergraduate Students

304. **Transport Phenomena. 4 hours.** Introduction to continuum theory of momentum,

energy, and mass transfer. Transport of scalar and vector quantities. Reynolds' transport theorem. General differential equations of transport phenomena. Momentum shell balances. Energy transport. Diffusion. Couple operations: free convection, simultaneous heat and mass transfer, etc. Prerequisite: EnrE. 201 or 211.

305.   **Statistical Thermodynamics. 4 hours.** Statistical formulation; partition functions, including quantum effect. Application to macroscopic systems; systems of interacting particles. Emphasis on engineering applications. Prerequisites: EnrE. 201; Math. 220 or the equivalent.

307.   **Kinetic Theory of Gases and Transport Phenomena. 4 hours.** Basic concepts of kinetic theory of gases. Equations of state and their molecular interpretation. Elementary classical statistics, molecular collisions. Application of the kinetic theory to viscosity, heat conduction, and diffusion. Prerequisite: Completion of core program.

310.   **Continuum Fluid Mechanics. 4 hours.** Development of the conservation equations for a Newtonian fluid: continuity, Navier-Stokes, and energy equations. Some exact and approximate solutions of highly viscous, viscous, and inviscid flow problems. Prerequisite: Math. 220 or the equivalent.

313.   **Aerodynamics of Flight. 4 hours.** Lift and drag, both subsonic and supersonic. Perturbation problems. Airfoil and slender body theories. Three-dimensional wings. Prerequisites: EnrE. 212 and 213.

314.   **Propulsion. 4 hours.** Thermodynamics and fluid mechanics of air breathing engines. Performance of rockets; chemical, nuclear, and electrical. Prerequisite: EnrE. 213.

321.   **Intermediate Heat Transfer. 4 hours.** Topics in conduction, convection, and radiation heat transfer, with special emphasis on the exact solutions of the problems. Two-phase flow; heat exchangers, mass transfer cooling; rarefied gas analysis. Prerequisites: EnrE. 221 and Math. 220.

341.   **Experimental Methods and Techniques. 4 hours.** Purpose and design of experiments; statistical analysis of errors; wind tunnel, shock tube, high vacuum and chemical reactor techniques; theory of mechanical, thermal, optical, and chemical measurements.

351.   **Electromechanical Energy Conversion I. 4 hours.** Conservation of energy, electromagnetic forces, applications to linear and nonlinear lumped-parameter systems, stability. Principles of rotating machines and equations of motion. Applications to synchronous, induction, d-c, and novel machines. Prerequisites: InfE. 221 and credit or registration in InfE. 311.

352.   **Electromechanical Energy Conversion II. 4 hours.** Continues Energy Engineering 351; completion of rotating machines. Interaction of electromagnetic fields with stationary and moving continuous media, Maxwell stress tensor, and waves and instabilities. Applications to energy conversion with emphasis on fluids (magnetohydrodynamics). Prerequisites: EnrE. 211, 351, and InfE. 320.

353.   **Direct Energy Conversion. 4 hours.** Novel methods of converting heat directly into

electrical energy. Consideration of magnetohydrodynamics, thermoelectrics, thermionics, and fuel cells. Prerequisites: EnrE. 202 and 352.

391. **Seminar. 1 to 4 hours.** May be repeated for additional credit. Topics to be arranged. Prerequisite: Consent of the instructor.

ENGLISH

John C. Johnson, Acting Head of the Department

Professors
Josephine W. Bennett (Visiting), John A. Conley, Dean B. Doner, Alexander Karanikas, Bernard R. Kogan, Jay A. Levine, Louis A. Marder, Ralph J. Mills, John F. Nims, Robert B. Ogle, Harry J. Runyan, Andrew Schiller, John B. Shipley, James B. Stronks, Samuel A. Weiss, Martin L. Wine, Elizabeth V. Wright

Associate Professors
Beverly Fields, Guinevere L. Griest, Adam Makkai, A. Lavonne Ruoff, Jaroslav Schejbal (Visiting), Mary Thale, Sylvan R. Weiner, Maurita Willett

Assistant Professors
Melvin H. Buxbaum, Archibald J. Byrne, Nancy R. Cirillo, William E. Doherty, Robert W. Gladish, Edith Gold, Hymen H. Hart, Dale S. Herron, Howard H. Kerr, David S. Lenfest, Vincent Louthan, Valerie B. Makkai, Patricia McFate, Irving M. Miller, Ted-Larry Pebworth, Catherine M. Shaw, Gerald C. Sorensen, Robert L. Vales

Instructors
Sondra Rosenberg, Florence R. Sandler

The department offers courses of study leading to the degree of Master of Arts in English, with specialization in literature or in linguistics.

Admission Requirements
Applicants must have a Bachelor of Arts or Bachelor of Science degree from an accredited college or university, and an overall grade-point average of at least B (4.00 on a 5.00 scale) for the last 90 quarter (60 semester) hours of undergraduate study.

Those applying for the literature program — what follows here does not

apply to students seeking to enter the linguistics program — must present the equivalent of 30 quarter hours of English and American literature, with no fewer than eight hours in each, including a course in Shakespeare. The 100-level sophomore survey sequences will not be counted toward the 30 hours. If a student whose undergraduate course work is deficient earns a high score on the Graduate Record Examination, he may be admitted after a favorable review by the departmental graduate committee. In some cases the committee may set prerequisites to be mady up, without graduate credit, in the student's first quarter(s) at Chicago Circle. The passing grade for a deficiency course is B.

In exceptional circumstances, the committee may accept an applicant with an average between 3.75 and 4.00. Such applicants may be admitted as regular students, if their Graduate Record Examination scores and other factors warrant it. Otherwise, these students and any others with an average between 3.50 and 3.75 who seem to warrant special consideration may be admitted on probation. However, the number of probationary admissions is limited.

All students applying for admission to the graduate program in English must submit the following:

an application form;

a transcript of undergraduate (and any graduate) course work;

two letters of recommendation, preferably from professors who are familiar with the student's recent work;

a statement of about 250 words presenting the applicant's reasons for wishing to take graduate work in English and the relationship of this work to his professional and other goals;

Graduate Record Examination scores for both the Aptitude and Advanced English Tests. Those applying for the linguistics program need take only the aptitude test.

Degree Requirements

M. A. in Literature

Hours. 48 quarter hours of course work are required, including English 400, Introduction to Bibliography and Research. At least 36 of the 48 hours must be in English; the remaining 12 hours may be in courses in other departments approved by the student's adviser.

Thesis. Optional; the student may write either a thesis or three Master's essays. Those electing to write a thesis will be held responsible for nine courses, including English 499, Thesis Research. Students under the nonthesis option must prepare 12 courses, at least nine of which must be in English, including English 400 and at least four other 400-level courses. In three of his 400-level courses the student will indicate that he wishes his seminar paper to be considered a Master's essay.

Applicants for the degree must demonstrate reading proficiency in French or German. Classical languages may be substituted, or another modern foreign language may be authorized by the departmental graduate committee.

All candidates are required to pass a comprehensive examination.

M. A. in Linguistics

All students are required to complete 48 quarter hours of course work, including English 315, Introduction to Descriptive Linguistics, and 400, Introduction to Bibliography and Research; to demonstrate reading proficiency in a foreign language; to write a thesis; and to pass a comprehensive examination.

Students may select either of two programs in linguistics:

The Terminal Master's Program in linguistics is intended primarily for teachers of English and other languages on the secondary level. Students who receive the terminal M. A. will not, presumably, go on to a doctorate and become professional linguists. Their course work, consequently, is intended to give them a general background in linguistics. Furthermore, since these are teachers, the emphasis is to some extent literary.

The Predoctoral Master's Program in linguistics aims to establish a firm groundwork for persons who intend to become professional linguists. Consequently, the emphasis is not literary or pedagogical, but scientific.

Courses for Graduate Students

400. **Introduction to Bibliography and Research. 4 hours.** Detailed study of bibliographic tools and examination of various kinds of research papers. Required of graduate students in English.

401. **Studies in Old English I. 4 hours.** Grammatical analysis of the major dialects; representative readings in each. Prerequisite: Engl. 314 or the equivalent.

402. **Studies in Old English II. 4 hours.** A detailed consideration of the Junius Manuscript, the Vercelli Book, or the Exeter Book. Prerequisite: Engl. 314 or the equivalent.

403. **Chaucer. 4 hours.** Critical study of *Canterbury Tales.*

404. **Chaucer. 4 hours.** Critical study of Chaucer's works, except *Canterbury Tales;* special emphasis on *Troilus and Criseyde.*

405. **Problems in Shakespeare Scholarship. 4 hours.** Biographical, bibliographical, and critical problems of Shakespearean scholarship and criticism as they relate to Shakespeare the man and to the study of the plays and poems. Prerequisite: At least one undergraduate course in Shakespeare above the 100 level.

417. **Studies in Sixteenth Century Literature. 4 hours.** May be repeated for a total of 12 hours. Detailed study of such special topics as a single figure, a genre, a group of figures, and stylistics.

418. **Studies in Seventeenth Century Literature. 4 hours.** May be repeated for a total of 12 hours. Detailed study of such special topics as a single figure, a genre, a group of figures, and stylistics. The content will be determined by the instructor and students and will vary from quarter to quarter.

419. **Milton. 4 hours.** Prose and poetry.

422. **Seminar in Prose Fiction from 1660 to 1800. 4 hours.** May be repeated for credit. Intensive study of a single figure, topic, or theme. Content will vary from quarter to quarter.

423. **Seminar in Poetry from 1660 to 1800. 4 hours.** May be repeated for credit. Intensive study of a single figure, topic, or theme. Content will vary from quarter to quarter.

424. **Seminar in Nonfiction Prose from 1660 to 1800. 4 hours.** May be repeated for credit. Intensive study of a single figure, topic, or theme. Content will vary from quarter to quarter.

425. **Studies in Romanticism. 4 hours.** Close examination either of a single important feature of the Romantic movement or of the chief works of one or two of the major Romantics. The content may vary from quarter to quarter, but the course will deal with important works by one or two major figures, with a subject, theme, or genre, or with a significant influence upon English Romanticism.

435. **Studies in Victorian Nonfiction Prose. 4 hours.** May be repeated three times with the approval of the department. Intensive study of social, political, and literary essays of the period.

436. **Studies in Victorian Poetry. 4 hours.** May be repeated for credit with the approval of the department. Intensive study of selected poets of the period.

437. **Studies in Victorian Fiction. 4 hours.** May be repeated for credit with the approval of the department. Intensive study of important writers of the period.

439. **The American Novel Since the Second World War. 4 hours.** Seminar on selected novels, emphasizing new trends.

440. **Studies in Modern British Poetry. 4 hours.** Major poets such as Yeats, Auden, and Thomas; 'traditional' figures such as Graves and Muir; and questions of tradition and innovation, poetry and politics, and the successive 'movements' in modern English verse.

441. **Studies in Modern British Drama. 4 hours.** Trends, authors, and forces shaping modern British drama and theater.

442. **Studies in Modern British Fiction. 4 hours.** Advanced studies of selected major figures, movements, themes, and techniques. Prerequisite: Engl. 290 or the equivalent.

445. **Studies in the Nineteenth Century American Novel. 4 hours.** Close reading of selected texts of novelists from Charles Brockden Brown to Stephen Crane.

446. **Studies in the Imagist Poets and Their Followers. 4 hours.** Poetry and theory of Ezra Pound, Richard Aldington, Hilda Doolittle, Amy Lowell, and others from 1912 to 1917. Imagist aspects of recent major poets.

447. **Studies in Negro Authors I: Langston Hughes and His Circle. 4 hours.** Assessment of the poetic impulse as revealed in the writings of Hughes and his contemporary Negro poets. A search for the roots of their self-expression.

448. **Studies in Negro Authors II: Richard Wright and Selected Contemporaries. 4 hours.** Search for common roots of experience realized in the writings (mainly fiction) of Wright, Jean Toomer, Ralph Ellison, Lorraine Hansberry, and others of their period.

449. **Studies in Negro Authors III: The Frame of Reference. 4 hours.** The role of the essayists. The writings of W. E. B. DuBois, James Weldon Johnson, Alain Locke, William Stanley Braithwaite, Saunders Redding, and others, leading to the contemporary group.

450. **Studies in American Thought and Culture. 4 hours.** Selected topics.

451. **Phonetics and Phonemics. 4 hours.** Principles of phonetics, articulatory, auditory, and acoustic. Phonemic analysis of English and other languages. Practice in transcription.

452. **Applied English Linguistics I. 4 hours.** Applications of linguistic science to the teaching of English syntax and grammar. Prerequisite: Engl. 387.

453. **Applied English Linguistics II. 4 hours.** Applications of linguistic science to problems of style, rhetoric, and metrics. Emphasis on the literary implications of linguistic knowledge. Prerequisite: Engl. 387.

454. **Linguistics and Language Learning. 4 hours.** Applications of linguistic science to the teaching of foreign languages. Development of comparative descriptions.

455. **Introduction to Indo-European Studies. 4 hours.** History of Indo-European studies; dialects of Indo-European; methodology of comparative and historical linguistics and its application to the reconstruction of Proto-Indo-European; current theories and problems of Proto-Indo-European phonology, morphology, and syntax. Prerequisite: A reading knowledge of French and German.

456. **Introduction to Old Norse. 4 hours.** Same as German 436. The grammar of Old Norse and the reading of selected prose and poetry. Prerequisite: A reading knowledge of some older Germanic dialect — Old English, Old Saxon, or Gothic.

457. **Introduction to Anglo-Norman. 4 hours.** The formation of Anglo-Norman from 850 to 1066, including its phonology, morphology, and syntax. Prerequisite: Engl. 301.

458. **Anglo-Norman and Middle English I. 4 hours.** The influence of Anglo-Norman on Middle English from 1066 to 1175; comparative morphology, phonology, and modifying influences. Prerequisite: Engl. 457.

459. **Anglo-Norman and Middle English II. 4 hours.** The influence of Anglo-Norman on Middle English from 1175 to 1250, the period of decline. Prerequisite: Engl. 458.

460. **Comparative Linguistics. 4 hours.** Introduction to diachronic linguistics and historical methods.

461. **Linguistic Analysis. 4 hours.** Bases of grammatical analysis, including phonology, syntax, and morphophonemics.

462. **Field Methods in Linguistics. 4 hours.** Recording and analysis of a language by means of native informants. Prerequisite: Engl. 451.

463. **Dialectology. 4 hours.** Description and mapping of dialects, both synchronically and diachronically. Methods of dialect geography. Prerequisite: Engl. 451.

464. **Lexicography. 4 hours.** Survey and critical evaluation of current methods and procedures in dictionary writing; practical applications.

465. **History of Linguistic Science. 4 hours.** Development of linguistic thought from its historical beginnings to the present. Prerequisite: Engl. 315.

466. **Morphology. 4 hours.** Introduction to the principles of morphological theory, including word formation. Consideration of the various possible approaches to morphological analysis and the historical evolution of the concept. Prerequisites: Engl. 315 and 451.

467. **Syntax. 4 hours.** Introduction to the methods of syntactic analysis as applied to English and other languages, both Indo-European and non-Indo-European. Prerequisite: Engl. 466.

470. **Language Typology. 4 hours.** Introduction to the history and methods of language typology from the nineteenth-century German Romantic philosophy (Wilhelm von Humboldt) through the early Indo-Europeanists and Edward Sapir to Greenberg's quantitative approach. Syntactic, lexicographic, and semantic typologies explored in addition to the traditional phonological and morphological ones. Prerequisites: Engl. 315 and 387 or the equivalents.

471. **Semantics. 4 hours.** Introduction to the history and methods of semantics from the nineteenth-century French positivist, Michel Breal, through the works of Wittgenstein, Bertrand Russell, and Korzibsky, up to modern works of Roger and Brown, Ulman, Wells, Weinreich, Lyons, Ziff, Katz and Fodor, and Lamb. The different schools of semantic analysis are discussed and evaluated. Prerequisites: Engl. 315 and 387 or the equivalents.

475. **Introduction to Computational Linguistics. 4 hours.** Introduction to the aims and methods of computer-aided linguistic analysis. Explanation of the basic workings of a computer; discussion of the nature of computer languages. Investigation of the ways a computer can be used to solve linguistic problems in the areas of phonology, morphology, syntax, translation, and lexicostatistics. Will include some actual work with the computer. No programming experience required. Prerequisite: Engl. 315 or the equivalent.

476. **Contemporary Movements in Linguistic Theory I: Advanced Structuralism and Tagmemics. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of structuralism and tagmemics. Prerequisites: Engl. 465 and 467.

477. **Contemporary Movements in Linguistic Theory II: Advanced Transformational-Generative Grammar. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of transformational-generative grammar. Prerequisite: Engl. 476.

478. **Contemporary Movements in Linguistic Theory III: Advanced Glossematics and Stratificational Grammar. 4 hours.** Analyzes and critically evaluates the theoretical contributions and descriptive methods of glossematics and stratificational grammar. Prerequisite: Engl. 477.

497. **Research in English. 4 hours.** May be repeated for a total of 16 hours. Students will be assigned to this course at the discretion of the department. Independent research in English and American literature and in linguistics.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Students will be assigned to this course at the discretion of the department. For students involved in thesis research and writing for advanced degrees.

Courses for Graduate and Advanced Undergraduate Students

301. **Introduction to the English Language. 4 hours.** English as a language. The basic concepts of general descriptive and comparative linguistics are used to examine the relationship of English to other languages, its history, and its present structure.

302. **Tennyson and Browning. 4 hours.** Close study of the lyric poetry and the dramatic monologues of Tennyson and Browning; briefer examination of Tennyson's Arthurian idylls and of the plays of both.

303. **Carlyle and Mill. 4 hours.** Major works.

305. **Newman and Arnold. 4 hours.** The prose of one early and one mid-Victorian writer: their contributions to nineteenth-century religious and educational theories. Arnold's literary and social criticism; the rhetoric of both. Brief reference to the poems and letters of each that most closely parallel ideas and moods in their prose.

306. **Dickens and Thackeray. 4 hours.** Close study of the major writings of the two representative Victorian novelists.

307. **Yeats and Eliot. 4 hours.** Detailed study of the two most influential poets in English of the twentieth century. Study of specific texts; some emphasis on the intellectual and spiritual attitudes represented by each.

311. **Chaucer. 4 hours.** Readings in the major works.

312. **Introduction to Old English. 4 hours.** Elements of Old English grammar and the reading of graded prose selections.

313. **Old English Poetry and Prose. 4 hours.** Heroic, elegiac, and religious poetry of England to 1200, exclusive of *Beowulf;* representative prose. Prerequisite: Engl. 312.

314. **Beowulf. 4 hours.** Detailed explication of the poem. Prerequisite: Engl. 313.

315. **Introduction to Descriptive Linguistics. 4 hours.** Introduction to theories of the syntactic, morphological, and phonological analysis and description of language.

316. **American Drama. 4 hours.** Major dramatic writings in American literature.

317. **The Writing of Poetry. 4 hours.** Limited to 15 students. May be repeated for a total of 12 hours. The practice of the writing of poetry, aided by intensive study of examples. Prerequisite: 12 hours of English literature.

318. **The Aesthetic Movement from 1850 to 1900. 4 hours.** Major figures and ideas behind the Pre-Raphaelite Brotherhood and the aesthetic movement in England.

319. **Introduction to Middle English. 4 hours.** A linguistic examination of Middle English and its dialects.

321. **Medieval Literature I. 4 hours.** Selected works in Middle English and continental medieval writings in English translation.

324. **Byron, Shelley, and Keats. 4 hours.** The major figures of the second generation of Romantics.

325. **The Writing of Fiction. 4 hours.** Limited to 15 students. May be repeated for a total of 12 hours. The practice of the writing of fiction, aided by intensive study of examples. Prerequisite: 8 hours of English literature.

331. **Important Minor Plays and Poems of Shakespeare. 4 hours.** Plays, poems, and sonnets. Prerequisite: Engl. 231 or 232.

334. **Literary Criticism, Theory, and Practice. 4 hours.** Survey of literary criticism, focusing on major critics from Plato to Arnold.

335. **Modern Literary Criticism. 4 hours.** Survey of modern literary criticism from Matthew Arnold to the present. Prerequisite: Engl. 334.

336. **Renaissance Drama Exclusive of Shakespeare. 4 hours.** Major dramatic works of Shakespeare's contemporaries.

337. **Exercises in Literary Criticism: Poetry. 4 hours.** Advanced course in practical criticism of poetry in English. Prerequisite: Engl. 335 or the equivalent.

338. **Tragedy. 4 hours.** A formal and theoretic inquiry into tragedy: its origins, evolution, and significance, based on selected masterworks of various periods.

339. **Comedy. 4 hours.** History and theory of comic drama.

341. **Dryden. 4 hours.** Poems, plays, and literary criticism; emphasis on the interaction of these genres in Dryden's development. Individual conferences on assigned papers are required.

345. **The Metaphysical Poets. 4 hours.** The poetry of Donne, Herbert, Vaughan, Crashaw. Special emphasis on Donne.

347. **Restoration Drama. 4 hours.** Major dramatic works after the reopening of the public theaters in 1660; development from aristocratic baroque tragedy and comedy to the beginnings of bourgeois sentimental drama. Dryden, Etherege, Wycherley, Congreve, Vanbrugh, Farquhar, Otway, Cibber, and others.

349. **Johnson and Boswell. 4 hours.** Principal writings.

350. **American Transcendentalists. 4 hours.** The Transcendentalist circle in and about Concord from 1830 to 1860: Emerson and Thoreau, Alcott, Brownson, Fuller, Ripley, Parker, Channing, and others. Prerequisite: Engl. 255 or Hist. 356 or 357.

352. **Pope. 4 hours.** Detailed study of the works of Alexander Pope in the light of the intellectual and aesthetic currents of the period.

353. **Eighteenth Century Drama. 4 hours.** Major dramatic works and trends. Among others, the following will be studied: Steele, Addison, Rowe, Gay, Lillo, Garrick, Cumberland, Goldsmith, Sheridan.

355. **American Fiction from 1800 to 1860. 4 hours.** Intensive study of the background and development of traditions and themes.

357. **Studies in the Short Story. 4 hours.** The short story as a literary form; close readings of selected short stories. Prerequisite: Consent of the instructor.

376. **W. D. Howells: Realism in Fiction and Criticism. 4 hours.** The career of William Dean Howells as a journalist, novelist, editor, and critic; his influence on the development of realism in late nineteenth and early twentieth century American literature.

377. **Naturalism in the American Novel: Dreiser, Crane, Norris, Lewis, and Others. 4 hours.** The development of the naturalistic novel; special emphasis on Dreiser and his followers.

380. **The Rise of Realism. 4 hours.** The rise of realism in American fiction from 1850 to 1900; Old Southwest humor, local color, Twain, Howells, Crane, the early naturalists, and others. Prerequisite: Engl. 256.

382. **The Plays of Bernard Shaw. 4 hours.** A critical, social, and philosophical inquiry.

385. **Faulkner and Hemingway. 4 hours.** Studies in the short stories and novels of the two writers; examination of their literary theories.

386. **Hawthorne and Melville. 4 hours.** Detailed analysis of one major novel of each. Prerequisite: Engl. 255.

387. **The Structure of English. 4 hours.** Traditional and structuralist grammatical descriptions; introduction to transformational grammatical studies; detailed survey of a transformational syntax of English; brief introduction to generative phonology and morphophonemic analysis of English, especially stress. Prerequisite: Engl. 301.

388. **Southern Fiction. 4 hours.** Major works.

389. **Walt Whitman and Emily Dickinson. 4 hours.** The poetry and major prose of Whitman; the poems of Emily Dickinson. Prerequisite: An A or a B in any one of the following: Engl. 256, 289, 302, 307, 323, 324, 345, or 366.

392. **The Negro in American Literature: Poetry. 4 hours.** Historical and analytical study of the Negro contribution to American poetry.

393. **The Negro in American Literature: Prose Fiction. 4 hours.** Historical and analytical study of the Negro contribution to American prose fiction.

394. **Studies in American Negro Literature. 4 hours.** Detailed study of aspects of writing by American Negroes.

399. **Independent Study. 1 to 4 hours.** Open only to English majors and graduate students in English. Admission to this course is only on advice of and initiated by the English Department. Individual studies under the direction of an assigned faculty member. Nature of the work is determined by the tutor on the basis of the student's needs and interests.

GEOLOGICAL SCIENCES

Professors
Werner H. Baur, Head of the Department; Robert W. Karpinski (emeritus)

Associate Professors
Robert E. DeMar, Helen M. McCammon (Visiting), Richard B. McCammon Istavros S. Papadopulos, Walter Sadlick

Assistant Professors
Warren C. Forbes, Jr., August F. Koster van Groos, Kelvin S. Rodolfo, Norman D. Smith, Ekkehart Tillmanns (Visiting)

Work leading to the degree of Master of Science is offered in these areas: crystallography, mineralogy, petrology, and geochemistry; paleontology; oceanography, sedimentology, and sedimentary geochemistry.

Admission Requirements

Admission generally requires a minimum grade-point average of 4.00. However, the department will rely strongly on recommendations from the applicant's undergraduate professors and on the grade-point average attained in the last two years of college. Geology students with a strong background in

mathematics, physics, chemistry, and biology will receive preference although students who have degrees in other sciences may be admitted. Serious deficiencies in undergraduate training in geology or other sciences will have to be corrected during the graduate program. The program will be selected by the student and his adviser(s) to correspond with his area of specialization.

Degree Requirements

Hours: 48 quarter hours, 24 of which must be in the area of concentration. The area of concentration may, as in the case of evolutionary paleontology, span several academic disciplines. A minimum of 16 quarter hours must be taken in 400-level courses; 8 of these should be in the area of concentration.

Thesis: The student must complete a written report or a thesis involving eight quarter hours of work on an independent study or research project selected with the approval of his faculty supervisor. The department may request the student to take a comprehensive examination in his area of specialization and independent study. The independent study report or thesis will be evaluated by a departmental committee including one member selected from outside the faculty of the Chicago Circle campus.

Candidates must demonstrate competence in reading the scientific literature of at least one foreign language. French, German, and Russian are the preferred languages.

Courses for Graduate Students

413. **Problems in Evolutionary Paleontology. 4 hours.** Same as Biological Sciences 413. Seminar on current problems. Discussion of evidence and mechanisms of change such as rates of evolution, population structure and extinction as shown by the vertebrate fossil record. Prerequisites: GeolS. 218 and BioS. 305. BioS. 345 is recommended.

420. **Advanced Vertebrate Paleontology. 4 hours.** Same as Biological Sciences 420. Given as three different courses. May be repeated twice for credit. Advanced treatment of the functional morphology, paleoecology, and phylogeny of the various vertebrate groups: fishes, amphibians and reptiles, and mammals. Prerequisites: GeolS. 318 and BioS. 282.

430. **Advanced Mineralogy. 4 hours.** May be repeated if the same topic is not covered twice. Various topics in one of the following categories: structural mineralogy, X-ray crystallography, optical properties of minerals, and crystal chemistry and mineral synthesis. Lectures, seminars, and laboratory. Prerequisites: GeolS. 206 and consent of the instructor.

432. **Advanced Geochemistry. 4 hours.** May be repeated if the same category is not covered twice. Advanced topics in one of the following categories: isotope geo-

chemistry and geochronology, distribution of elements in the earth's crust, mineral systems with and without volatile components, and low-temperature mineral systems. Lectures, seminar, and laboratory. Prerequisites: GeolS. 335 and consent of the instructor.

460. **Marine Geology. 4 hours.** Origin and nature of marine sediments, tectonics and geomorphology of the ocean floor, including methods of mapping and measuring submarine topography. Prerequisites: GeolS. 220 and 340.

495. **Advanced Studies in Geology. 2 to 8 hours.** May be repeated twice. Independent study or research under a faculty supervisor culminating in a written report. Work may be taken in the following fields: stratigraphy, sedimentation, paleontology and paleoecology, vertebrate paleontology, mineralogy and petrology, crystallography, geochemistry, engineering geology, oceanography. Prerequisites: Consent of the head of the department and the faculty member who will act as study supervisor.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Individual work under the supervision of faculty members in their respective fields. Prerequisites: Consent of the thesis supervisor and the head of the department.

Courses for Graduate and Advanced Undergraduate Students

303. **Advanced Physical Geology I. 4 hours.** The physical nature of the earth; the manner in which the materials of the earth determine structure; description of earth structures and structural processes; techniques of structural analysis. Prerequisites: GeolS. 103, and 206, and consent of the instructor.

304. **Advanced Physical Geology II. 4 hours.** Problems in earth chemistry, physics, and history. Prerequisite: GeolS. 303.

316. **Invertebrate Paleontology. 4 hours.** Same as Biological Sciences 316. Phylogeny, morphology, and ecology of the fossil invertebrates. Prerequisites: GeolS. 218 and consent of the instructor.

317. **Field Geology in the Rocky Mountains. 12 hours.** Field course conducted from a locality in the Rocky Mountains. Field training in stratigraphy, structure, and geomorphology; geologic mapping with plane table and serial photographs. Approximate cost $250 to $305. Prerequisites: GeolS. 103 and 206.

318. **Vertebrate Paleontology. 4 hours.** Same as Biological Sciences 318. Phylogeny, morphology, and ecology of the fossil vertebrates. Prerequisite: One year of biological sciences and consent of the instructor.

319. **Paleobotany. 5 hours.** Same as Biological Sciences 319. Structure, phylogeny, and stratigraphic distribution of representative fossil plants. Lecture, laboratory, and field trips. Prerequisite: One year of biological sciences.

335. **Geochemistry. 4 hours.** Principles of the distribution of the elements in the earth's crust. Element partitioning between coexisting minerals; origin of the elements. Introduction to thermodynamic consideration of mineral equilibria. Prerequisite: Chem. 114.

340. **Introduction to Oceanography. 4 hours.** Physical description of the marine environment; physical and chemical properties of sea water; currents, wave action, tidal forces, geography and geology of the ocean basins. Relation of the marine organism to the physical environment. Prerequisite: Consent of the instructor.

345. **Advanced Crystallography. 4 hours.** Crystalline properties of minerals. Theory and practice of determining the crystalline structure of minerals. Prerequisite: GeolS. 205.

350. **Hydrogeology. 4 hours.** Geology of the occurrence, storage, movement, and quality of water in rocks of the earth's crust. Prerequisites: GeolS. 103 and 220; credit or concurrent registration in Math. 133.

360. **Introductory Geophysics. 4 hours.** The shape and figure of the earth, gravity, seismology, and magnetism. Thermodynamics of the earth; atmospheric and planetary geophysics. Prerequisite: Consent of the instructor.

365. **Statistical Methods in Geology. 4 hours.** Introductory course. Sampling from geological populations, statistical inference, and hypothesis testing; statistics of orientation data; trend surface methods; multivariate correlation techniques; time series analysis. Prerequisite: Math. 370.

370. **Engineering Geology. 4 hours.** Applications of geology to major engineering problems and operations. Prerequisites: GeolS. 150, 206, Math. 132, and Phys. 114.

380. **Earth Science for Teachers. 9 hours.** Survey of the earth sciences; particular attention to the Earth Science Curriculum Project (ESCP) materials. Emphasis on the interdisciplinary nature of and investigative approach toward earth science. Prerequisites: Bachelor's degree in science or mathematics, enrollment in NSF In-Service Institute for Secondary School Teachers, and consent of the instructor.

GERMAN

Professors
Robert R. Heitner, Head of the Department; Lee B. Jennings, Robert Kauf, Daniel C. McCluney, Jr., Leroy R. Shaw, Elizabeth Teichmann, Hazel C. Vardaman

Associate Professors
Arnold J. Hartoch, Ernest S. Willner

Assistant Professors
Else Huenert-Hofmann, Karl F. Otto, Jr., Marilyn J. Torbruegge

Work leading to the degree of Master of Arts is offered in two areas of specialization: German literature; German philology and linguistics.

Admission Requirements

Applicants must have a Bachelor's degree with a major in German from an accredited institution or the equivalent from a foreign university. Those whose undergraduate preparation in German is deemed inadequate may be admitted at the discretion of the department but will be required to take supplementary course work on the undergraduate level. Applicants are expected to have a grade-point average of 4.00 in their undergraduate work in German; those with averages between 3.50 and 4.00 may be considered on an individual basis.

Entering students must have the ability to read literary and critical German with speed and accuracy and to follow class lectures in German. They should also have an elementary acquaintance with German linguistics and some knowledge of the main outlines of German literature from 1750 to the present.

Degree Requirements

The candidate must take a minimum of 48 quarter hours of course work, including at least 36 hours in the major field (18 of these must be in 400-level courses), and at least one graduate seminar in German. He must also prepare an acceptable thesis or departmental Master's paper and must pass a final comprehensive examination on his:

ability to write and speak German;

knowledge of the linguistics, grammar, history, and structure of the German language;

knowledge of the main outlines of German literature and culture;

competence in a concentrated field of specialization in German linguistics or literature.

Courses for Graduate Students

404.   **Theories of German Phonetics and Phonology.** 4 hours. Introduction to phonological and phonetical analysis of the German language. Prerequisite: Consent of the instructor.

405.   **History of the German Language.** 4 hours. Structural and lexical development.

408.   **Bibliography and Research Methods.** 4 hours.

410.   **Middle High German.** 4 hours.

420.   **Medieval Literature.** 4 hours. German literature from 1100 to 1400. Prerequisites: Ger. 382 and 410 or the equivalents.

421. **Renaissance and Reformation Literature. 4 hours.** Prerequisite: Ger. 382 or the equivalent.

422. **Baroque Literature. 4 hours.** Prerequisite: Ger. 382 or the equivalent.

423. **Enlightenment and Sturm and Drang Literature. 4 hours.**

425. **Goethe and Schiller — The Weimar Period. 4 hours.**

426. **Romanticism. 4 hours.** Literature, theories, and philosophy of eighteenth and nineteenth-century German Romanticism.

427. **Poetic Realism. 4 hours.** German literature between Romanticism and Naturalism.

428. **Modern German Literature from 1890 to 1930. 4 hours.**

429. **Contemporary Literature. 4 hours.** German drama, lyric and narrative prose from 1930 to the present.

432. **Old High German. 4 hours.** Introduction to sounds, morphology, and syntax. Reading of Old High German literary texts. Prerequisite: Ger. 405.

433. **Old Saxon. 4 hours.** Introduction to sounds, morphology, and syntax. Reading of Old Saxon literary texts. Comparison of Old Saxon, Old English, and Old High German. Prerequisite: Ger. 405.

434. **Gothic. 4 hours.** Introduction to sounds, morphology, and syntax. Reading of Gothic literary texts. Prerequisite: Ger. 405.

436. **Introduction to Old Norse. 4 hours.** Same as English 456. The grammar of Old Norse and the reading of selected prose and poetry. Prerequisite: A reading knowledge of some other older Germanic dialect such as Old English, Old Saxon, or Gothic.

440. **Seminar in Literature. 4 hours.** May be repeated for credit. Topics will vary. Prerequisite: Consent of the instructor.

441. **Seminar in Linguistics. 4 hours.** May be repeated for credit. Topics will vary. Prerequisite: Consent of the instructor.

447. **Laboratory Measurement of Phonetics. 4 hours.** Electroacoustic analysis of spoken German by means of special instruments for automatic graphic recording in the German Linguistic Research Laboratory. Prerequisite: Ger. 404 and consent of the instructor.

448. **The Structure of Modern German. 4 hours.** Structural analysis of modern High German by means of modern European and American methods. Prerequisites: Ger. 403 and 405.

490. **Independent Study for Graduate Students. 1 to 16 hours.** Prerequisite: Consent of the instructor.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Prerequisite: Approval of the department.

Courses for Graduate and Advanced Undergraduate Students

320. **Practical Stylistics and Analytical Grammar I. 3 hours.** Prerequisite: Ger. 204 or the equivalent.

321. **Practical Stylistics and Analytical Grammar II. 3 hours.** Prerequisite: Ger. 320 or the equivalent.

370. **The German Novelle. 4 hours.** Reading and interpretation of representative *Novellen* of the nineteenth and twentieth centuries. Prerequisites: Ger. 221 and two additional German literature courses.

372. **German Drama. 4 hours.** Development of the German drama from the Enlightenment to the present. Prerequisites: Ger. 221 and two additional German literature courses.

374. **Poetry from the Seventeenth Century to the Present. 4 hours.** Prerequisites: Ger. 221 and two additional German literature courses.

380. **Goethe's *Faust*. 4 hours.** Intensive study of Parts I and II. Prerequisites: Ger. 221 and two additional German literature courses.

382. **German Literature to 1750. 4 hours.** Prerequisites: Ger. 221 and two additional German literature courses.

385. **Germanic Linguistics. 4 hours.** Linguistic geography, *Sprachschichten,* and principles of structural linguistics. Prerequisite: Ger. 203 or the equivalent.

390. **Topics in German Literature. 4 hours.** May be taken more than once for credit. Reading and discussion of the work of one prominent German author or of a group of related authors. Subject varies and is chosen by the instructor. Prerequisites: Ger. 290, 292, and 294.

HISTORY

Professors
Robert V. Remini, Chairman of the Department; Shirley A. Bill, Bentley Gilbert, Louis Gottschalk (Visiting), Peter d'A. Jones, Stanley L. Jones, Robert L. Nicholson, Gilbert Osofsky, Edward C. Thaden, John B. Wolf

Associate Professors
Peter J. Coleman, Carolyn A. Edie, Margaret Y. George, Robert L. Hess, Melvin G. Holli, Kenneth A. Lockridge, Richard Millman

Assistant Professors
Robert E. Conrad, George Huppert, David Jordan, Ronald P. Legon, Peter R. McKeon, Karl A. Schleunes

The Department of History offers work leading to the degrees of Master of Arts and Doctor of Philosophy.

Admission Requirements

Applicants must have a grade-point average of at least 4.00 for the last 90 quarter hours of undergraduate study. Students with averages below 4.00 but above 3.75 are considered on an individual basis. Three letters of recommendation from former professors are required of all applicants. Students are urged to take the Graduate Record Examination, although it is not a requirement.

Hours: A student must present a Bachelor of Arts degree with a major in history or with a minimum of 24 quarter hours in history, or he may petition the department for admission. Only in the most exceptional cases will part-time students be admitted as Master of Arts candidates. (Full time is defined as 12 or more quarter hours.) The department may require a candidate to make up any deficiencies in his preparation before granting him full standing in the graduate program. A minimum of two years of undergraduate training in a foreign language is required.

Degree Requirements

Master of Arts

The candidate must pass a comprehensive examination in one major field and two minor fields selected from among the following areas of specialization: ancient world, medieval Europe, early modern Europe, modern Europe, Russia, Great Britain, America (United States), Africa, imperialism and colonialism, and historiography. Candidates are expected to take at least 12 hours in each of two of these fields of specialization. A minimum of 48 quarter hours is required for the degree, 16 of which must be at the 400 level. Of these 16 hours, 12 must be in history courses. A student who has done graduate work in a recognized institution without receiving a degree may petition to receive credit by examination. No thesis is required. The candidate must pass a reading examination in a foreign language relevant to his program of study. The language presented to meet this requirement must be approved by the department. For work in certain fields, a reading knowledge of the particular language or languages relevant to that field may be required.* With the approval of the department a student may take a minor in another discipline.

*Students planning to transfer to another school to continue graduate work beyond the M.A. are advised to check the foreign language requirements at that school.

The candidate must maintain an average of at least 4.00. No credit toward the degree will be given for any course in which the student receives a grade of less than B.

Doctor of Philosophy

The department offers work leading to the doctorate in the fields of European and American history.

The doctorate in history represents mastery of several general areas of historical knowledge and calls for an original contribution to scholarship through independent study and research. Ordinarily, the candidate will complete a minimum of 48 quarter hours of graduate courses and seminars beyond the Master's degree.

The requirement of the Graduate College for the doctorate is 96 quarter hours of work beyond the Master of Arts degree. A student may expect to take approximately 48 quarter hours of thesis research.

Unless the candidate holds a Master of Arts degree from the University of Illinois at Chicago Circle or from an accredited institution and has been recommended for further advanced study, he will be expected to take a qualifying examination for the M. A. The candidate for the degree must also stand for oral and written preliminary examinations. Lastly, he must present an acceptable dissertation and defend it in a final oral examination.

Any Chicago Circle student who intends to take work leading to the Ph.D. must take an oral examination within two weeks after passing the Master's comprehensive examination. The oral examination requirement will not be applicable to anyone who has passed the Master's comprehensive examination prior to May 1969. All new applicants for the Ph.D. at Chicago Circle will be evaluated after the completion of their first quarter by relevant professors. The department may require such students to take an oral examination at that time.

All Ph.D. candidates must have a reading knowledge of two foreign languages. In many fields of history command of a foreign language is indispensable for advanced study and research, and it is expected that that language will be used in course and seminar work as required. In some fields it is recognized that other tools, such as statistical theory, may be equally indispensable.

The program of study for each candidate will be fixed by the candidate and his adviser with the approval of the graduate advisory committee of the Department of History.

Candidates must offer one major field of preparation and three minor fields, one of which may be outside the department, for the preliminary examinations. Two of the minor fields must be either geographically or chronologically outside the areas of his major field. The major fields of study offered by the department are: European history from 1450 to 1815; European history since 1648; American history from 1500 to 1877; American history since 1765; Russian

history; British history since 1688. Minor fields in European history are the Age of the Enlightenment, diplomatic history since 1648, Bourbon France, revolutionary and Napoleonic France, Italy since 1789, intellectual history since 1815, Great Britain since 1837; imperialism and colonialism, historiography; in American history, they are economic history, Negro history, political parties, urban history, early national period, the Jacksonian Era, the Civil War and Reconstruction, the progressive era, and the contemporary United States. Fields other than those listed may be accepted in individual cases. The work that a candidate may offer in other departments shall be determined in consultation with his adviser.

Urban Studies and Negro History. Graduate students will have an opportunity to pursue research in American urban studies and Negro history in the University's Urban History Manuscript Collection, a rich repository of materials dealing with the social, economic, and political history of the United States and particularly with the history of the metropolitan Chicago area. Through the materials in this collection, students in history will be trained in the use of manuscripts as well as other primary materials employed in the study and writing of history.

Courses for Graduate Students

Note: Seminars are generally offered in two-quarter or three-quarter sequences. Several seminar sections are offered in European, American, and British research topics each year. Students may enroll in more than one section.

413. **Seminar in Ancient History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.

417. **Seminar in Medieval History. 4 hours.**

418. **Seminar in Renaissance History. 4 hours.**

421. **Seminar in European History. 4 hours.**

428. **Seminar in African History. 4 hours.**

429. **Seminar in Russian History. 4 hours.**

433. **Seminar in British History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.

451. **Seminar in American History. 4 hours.** May be repeated for credit for a maximum of 48 hours. Concurrent registration in more than one section permitted for a maximum of 16 hours per quarter.

452. **Seminar in Urban History. 4 hours.**

479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology. 2 hours.** Same as Philosophy 479 and Psychology 479. May be repeated. Systematic review of special topics; emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

491. **Historical Methods. 4 hours.** A laboratory course to provide understanding of the study of history and practical application of the methods by which the past is reconstructed.

492. **Historiography. 4 hours.** Great historians from early times to the present.

497. **Research and Writing. 0 to 12 hours.** Special problems in research and individual guidance in the preparation of Master's research essays.

498. **Independent Study. 0 to 12 hours.**

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit.

Courses for Graduate and Advanced Undergraduate Students

Note: Graduate students must have background or training appropriate to the content of any 300-level course.

301. **Church and State in Medieval Europe, the Eleventh Through the Twelfth Centuries. 4 hours.** Development of papal centralization from 1049 to 1123, examination of the church under feudal domination, the reforms of the Saxon and Salian emperors, and the origins of papal independence. The basic opposition between imperial and papal assertions of hegemony and the dispute over lay investiture as an aspect of the controversy are the focal points for study of the ecclesiology of Gregory VII and his successor. Individual conferences on assigned papers are required.

302. **Byzantine Civilization from 330 to 1054. 4 hours.** Cultural, religious, and social history of the Eastern Roman Empire from the founding of Constantinople to 1054. Special attention to the continuation of classic ideals and Byzantine relations with the Latin West and the Slavic, especially the Russian, worlds. Individual conferences on assigned papers are required.

303. **History of Byzantine Civilization from 1054 to 1453. 4 hours.** Cultural, religious, and social history of the Eastern Roman Empire from 1054 to the fall of Byzantium. Special attention to the continuation of classic ideals and Byzantine relations with the Latin West and the Slavic, especially the Russian, worlds. Individual conferences on assigned papers are required.

304. **Intellectual History of the Medieval Western World. 4 hours.** Intellectual and religious thought and learning from the Age of the Fathers to Dante and William of Occam. Some attention to cross-cultural relations with the Byzantine and Islamic East. Individual conferences on assigned papers are required.

305. **The Middle Ages from 400 to 814. 4 hours.** Europe from the time of the barbarian invasions to the death of Charlemagne. Individual conferences on assigned papers are required.

306. **The Middle Ages from 814 to 1250. 4 hours.** Europe from the death of Charlemagne to the death of Frederick II. Individual conferences on assigned papers are required.

307. **The Middle Ages from 1250 to 1500. 4 hours.** Europe from the rise of the towns to the establishment of national monarchy. Individual conferences on assigned papers are required.

308. **The Renaissance. 4 hours.** Major intellectual, cultural, political, social, and economic developments and issues of Renaissance Europe. Individual conferences on assigned papers are required.

309. **History of Russian Foreign Policy to 1917. 4 hours.** Russian foreign policy from the reign of Peter I to the revolution. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.

310. **Modern Russian Intellectual and Cultural History. 4 hours.** Development of Russian culture, social and political thought, and philosophy during the eighteenth and nineteenth centuries. Individual conferences on assigned papers are required.

311. **The Age of the Reformation. 4 hours.** The Protestant and Catholic reformations of the sixteenth century. Individual conferences on assigned papers are required. Prerequisite: One year of European history.

312. **The Age of Philip II. 4 hours.** Europe during the second half of the sixteenth century, the age of Spanish imperialism; religious war and economic expansion. Individual conferences on assigned papers are required.

313. **Sixteenth Century Civilization in Europe. 4 hours.** European culture from the generation of Copernicus to the generation of Galileo. Origins of modern thought and ideology in the context of sixteenth-century society. Individual conferences on assigned papers are required.

314. **Europe in the Seventeenth Century. 4 hours.** Major political, religious, economic, social, and cultural developments and issues of seventeeth-century Europe. The growth of the French monarchy, the Hapsburg Empire, the Thirty Years' War, the English constitutional crises, international problems and politics, political theory, the scientific revolution, and economic and social problems. Individual conferences on assigned papers are required.

315. **Europe in the Eighteenth Century. 4 hours.** Major features of the structure and operations of international relations, diplomacy, and warfare in the eighteenth century; economic and political systems of the major states of Western Europe from 1715 to 1789. Individual conferences on assigned papers are required.

316. **Europe from 1789 to 1848: Revolution and Reaction. 4 hours.** The French Revolution; Napoleon and the emergence of a new Europe with the forces of liberalism, nationalism, Romanticism, and conservatism; the meeting of these forces in the revolutions of 1848. Individual conferences on assigned papers are required.

317. **Europe from 1848 to 1914: Unification, Power, and Conflict. 4 hours.** The unification of Germany and Italy, the rise of industrialism and the new imperialism, the advent of *Realpolitik* and the background of World War I. Individual conferences on assigned papers are required.

318. **Europe from 1914 to the Present: Power, Conflict, and the Cold War. 4 hours.** Contentions among fascism, communism, and liberal democracy to reconstitute Europe after 1918. Background of World War II and Europe in a cold war. Individual conferences on assigned papers are required.

319. **European Diplomatic History from 1648 to 1814. 4 hours.** Foreign policy of European states from the Treaty of Westphalia to the fall of Napoleon. Individual conferences on assigned papers are required.

320. **European Diplomatic History from 1814 to 1878. 4 hours.** Foreign policy of European states from the fall of Napoleon to the Congress of Berlin. Individual conferences on assigned papers are required.

321. **The Diplomacy of Imperialism from 1878 to the Present. 4 hours.** European relations with the non-European world: late nineteenth century imperialism, the creation, administration, and disintegration of colonial empires and the emergence of new nations in an age of decolonization. Individual conferences on assigned papers are required.

322. **Bourbon France from 1589 to 1685. 4 hours.** Political, social, economic, and intellectual history of France under the Bourbon monarchy to the early years of Louis XIV. Individual conferences on assigned papers are required.

323. **Ideas and Ideologies in Nineteenth Century European Thought. 4 hours.** Major ideas and ideologies of Europe in the nineteenth century, from Romanticism to late-century Social Darwinism. Prerequisite: One year of modern European history.

324. **Ideas and Ideologies in Twentieth Century Thought. 4 hours.** Important intellectual trends in the modern world: Freudianism and the new science of man, Spenglerian "decline of the West," Marxism-Leninism, the irrationalism of fascism, the post-war existentialist dilemma. Prerequisite: Hist. 323 and one year of European history.

325. **Italian History from 1815 to 1870. 4 hours.** Impact of the French Revolution, the *Risorgimento*, the creation of the Italian nation-state and the early years of the Kingdom of Italy. Individual conferences on assigned papers are required.

326. **Italian History from 1870 to the Present. 4 hours.** Development of the Italian national state: political, social, and economic problems of Italy before World War I, the church-state relationship, colonial ambitions, the fascist corporate state, the Italian Republic since World War II. Individual conferences on assigned papers are required.

327. **German History from 1618 to 1740. 4 hours.** The Thirty Years' War: its political, economic, and social effects on German public life. The rise of absolutism, the decline of the *Reich*, economic reconstruction and cameralism, the changing structure of social relationships. Individual conferences on assigned papers are required.

328. **German History from 1740 to 1848. 4 hours.** The rise of Prussia and Austro-Prussian dualism; enlightened absolutism in Germany; Germany in the revolutionary period; the rise of political ideologies and middle-class culture; the revolutions of 1848. Individual conferences on assigned papers are required.

329. **Modern Germany from 1848 to the Present. 4 hours.** Germany's political, economic, and social reaction to the problems of national unification, industrialism, liberalism, world-power status, and rejuvenation after the loss of that status in the two World Wars. Individual conferences on assigned papers are required. Prerequisite: One year of European history.

330. **History of European Economic Life from 1500 to 1750. 4 hours.** Breakup of traditional European societies and the emergence of preindustrial capitalist forms in the Western world before the Industrial Revolution. Individual conferences on assigned papers are required.

331. **History of European Economic Life from 1750 to 1870. 4 hours.** Creation of industrial society in Britain and its diffusion to Western Europe. Prerequisite: Consent of the instructor.

332. **History of European Economic Life Since 1870. 4 hours.** The continuing spread of industrial society throughout Europe since the climacteric of the 1870's; problems of mature capitalist societies and the emergence of a post-industrial economic order. Prerequisite: Consent of the instructor.

333. **History of East Central Europe Since 1526. 4 hours.** Political, social, economic, and cultural development of Austria, Hungary, Poland, and the Czechoslovak lands from the Battle of Mohacs to the present. Prerequisite: Consent of the instructor.

334. **Colonial Mexico. 4 hours.** The Indian background of Mexico, the Spanish conquest, the amalgamation of Spanish and indigenous cultures, and the evolution of Mexican economic, religious, social, and political institutions under Spanish domination until 1821. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.

335. **The Mexican Nation from 1821 to 1910. 4 hours.** Social, economic, political, and cultural development of Mexico from independence to the fall of Porfirio Diaz. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.

336. **Mexico Since 1910. 4 hours.** The Mexican Revolution and the development of the modern nation. Prerequisite: Consent of the instructor.

337. **Tudor England from 1485 to 1603. 4 hours.** Major political, constitutional, social, economic, and cultural developments and issues of Tudor England. Individual conferences on assigned papers are required.

338. **Stuart England from 1603 to 1714. 4 hours.** Major political, constitutional, social, economic, and cultural developments and issues of Stuart England. Individual conferences on assigned papers are required.

339. **Eighteenth Century England from 1714 to 1815. 4 hours.** From the accession of the

Hanoverians to the end of the Napoleonic wars. Individual conferences on assigned papers are required.

340.   **Nineteenth Century England from 1815 to 1886. 4 hours.** From the end of the Napoleonic wars to the Home Rule election. Individual conferences on assigned papers are required.

341.   **Twentieth Century England from 1886 to the Present. 4 hours.** From the Home Rule election to the present. Individual conferences on assigned papers are required.

342.   **Social and Economic Development of Modern Britain. 4 hours.** British economic developments since the Industrial Revolution; social and political response to industrial society; rise of the Labour party and the welfare state. Individual conferences on assigned papers are required. Prerequisite: Hist. 133.

343.   **English Constitutional History to 1485. 4 hours.** Foundation and development of British constitutional, political, and legal institutions from Anglo-Saxon times to the accession of the Tudor dynasty. Individual conferences on assigned papers are required. Prerequisite: One year of British history or one year of medieval history.

344.   **English Constitutional History from 1485 to the Present. 4 hours.** Growth, development, and change in British constitutional, political, legal, and imperial institutions from the accession of the Tudor dynasty to the present. Individual conferences on assigned papers are required. Prerequisite: One year of British history or one year of modern European history.

345.   **History of Western Africa and the Sudan. 4 hours.** Development of native African states from earliest times; impact of European and other alien influences on the continent; emergence of the modern independent African states. Individual conferences on assigned papers are required.

346.   **Eastern Africa and the Horn. 4 hours.** Development of native African states from earliest times; impact of European and other alien influences on the continent; emergence of modern independent African states. Individual conferences on assigned papers are required.

347.   **Southern Africa and the Congo. 4 hours.** Development of native African states from earliest times; impact of European and other alien influences on the continent; emergence of modern independent African states. Individual conferences on assigned papers are required.

348.   **The Portuguese Empire in Brazil. 4 hours.** Portuguese discovery, settlement, and exploitation of Brazil during three centuries; creation of the Brazilian nation through an amalgamation of races and cultures in a plantation and mining economy.

349.   **Monarchy in Brazil from 1808 to 1889. 4 hours.** Foundation of Brazilian independence; consolidation of the nation; its economic, social, political, and intellectual development.

350.   **Modern Brazil from 1889 to the Present. 4 hours.** The conservative republic, the revolution of 1930, the Vargas Era, economic, social, cultural development, and the struggle for modernization.

351. **Discovery and Settlement of the Americas in the Sixteenth and Seventeenth Centuries. 4 hours.** Development of the Americas; early phases of European interests in the Atlantic community; the first century of British North America. Individual conferences on assigned papers are required.

352. **British North America from 1690 to 1765. 4 hours.** The duel with France for empire; development of British North America to the eve of American independence. Individual conferences on assigned papers are required.

353. **Development of the American Nation from 1765 to 1801. 4 hours.** Background for independence; the American Revolution; establishment of government. Individual conferences on assigned papers are required.

354. **The New Nation: The United States from 1789 to 1828. 4 hours.** Establishment of the American nation under the constitution. Emergence of the political party system; westward expansion; growth of nationalism and sectionalism. Individual conferences on assigned papers are required.

355. **The Jacksonian Age: The United States from 1828 to 1848. 4 hours.** Political, social, and cultural developments during the middle period. Individual conferences on assigned papers are required.

356. **Expansion and Conflict: The United States from 1848 to 1865. 4 hours.** Causes and events leading to the Civil War; Lincoln and the war. Individual conferences on assigned papers are required.

357. **The Politics of Reform in Industrial American from 1877 to 1912. 4 hours.** Agrarian protest, organization of labor, third-party movements and progressivism in the period of rapid social and economic change at the turn of the century. Individual conferences on assigned papers are required.

358. **Response to Crisis: Twentieth Century America in War and Depression from 1912 to 1939. 4 hours.** The American response to World War I and to the depression of the 1930's. Analysis of political, social, economic, and intellectual tendencies. Individual conferences on assigned papers are required.

359. **Studies in Contemporary American History: The United States from 1939 to the Present. 4 hours.** World War II, post-war diplomacy, political, social, economic, and intellectual tendencies. Individual conferences on assigned papers are required.

360. **Reconstruction: The United States from 1865 to 1877. 4 hours.** Reconstruction of the Union following the Civil War. Individual conferences on assigned papers are required.

361. **The Land and the Nation. 4 hours.** Analysis of the influence of public domains on American development from colonial times to the Civil War. Emphasis on political, institutional, constitutional, and ideological topics. Individual conferences on assigned papers are required.

362. **The United States and Its Natural Heritage. 4 hours.** Analysis of the contest that developed after 1865 for the control and utilization of America's natural resources.

Emphasis on political, institutional, economic, social, and ideological topics. Individual conferences on assigned papers are required.

363.   **American Intellectual and Social Thought from 1600 to 1830. 4 hours.** Representative cultural statements from American Puritanism, the Enlightenment, Romanticism, and Pragmatism. Individual conferences on assigned papers are required.

364.   **American Intellectual and Social Thought from 1831 to 1890. 4 hours.** Representative cultural statements from American Puritanism, the Enlightenment, Romanticism, and Pragmatism. Individual conferences on assigned papers are required.

365.   **Development of the American Economy from 1607 to 1815. 4 hours.** Analysis of the main currents and factors in the economic development of the United States from colonial times to the War of 1812. Special attention to the relationship of economic institutions and activities to social and political trends in American civilization. Individual conferences on assigned papers are required.

366.   **Development of the American Economy from 1815 to 1917. 4 hours.** Analysis of the main currents and factors in the economic development of the United States from the War of 1812 to World War I. Special attention to the relationship of economic institutions and activities to social and political trends in American civilization. Individual conferences on assigned papers are required.

367.   **Diplomatic History of the United States from 1775 to 1880. 4 hours.** Development of American relationships in the New World and with the nations of Europe and Asia. Individual conferences on assigned papers are required.

368.   **Diplomatic History of the United States from 1880 to the Present. 4 hours.** Emergence of the United States as a world power. Individual conferences on assigned papers are required.

369.   **Constitutional Development of the United States to 1840. 4 hours.** Individual conferences on assigned papers are required. Prerequisite: One year of United States history, British history, or political science.

370.   **Constitutional Development of the United States from 1840 to 1900. 4 hours.** Individual conferences on assigned papers are required. Prerequisite: One year of United States history, British history, or political science.

372.   **Development of the American Economy from 1917 to the Present. 4 hours.** Analysis of the main currents and factors in the economic development of the United States since World War I. Special attention to the relationship of economic institutions and activities to social and political trends in American civilization. Individual conferences on assigned papers are required.

373.   **American Urban History: The Colonial Period to the 1860's. 4 hours.** Major causes for and consequences of the emergence of American cities from the seventeenth century to the Civil War. Individual conferences on assigned papers are required. Prerequisite: One year of introductory American history.

374.   **American Urban History: The 1860's to the Present. 4 hours.** Major causes for and consequences of the emergence of the industrialized city: industrial revolution, labor

movement, architectural revolution, ethnic groups, housing, health, social reform, and others. Individual conferences on assigned papers are required. Prerequisite: One year of introductory American history.

375. **Studies in American Urban History. 4 hours.** Individual training in research in urban history and discussion of selected major problems of American urbanization. Individual conferences on assigned papers are required. Prerequisites: Hist. 373 and 374.

376. **American Intellectual and Social Thought from 1891 to the Present. 4 hours.** Representative cultural statements from American Puritanism, the Enlightenment, Romanticism, and Pragmatism. Individual conferences on assigned papers are required.

377. **American Racial History to the Civil War. 4 hours.** History of race relations in America: special emphasis on Negro-white relations, American Negro history, and the manner in which concern for race has been transformed into issues of national importance from the earliest Western contacts with Africa through the Abolitionist Era. Individual conferences on assigned papers are required. Prerequisite: One year of introductory American history, political science, or sociology.

378. **American Racial History Since the Civil War. 4 hours.** History of race relations in America; special emphasis on Negro-white relations, American Negro history, and the manner in which concern for race has been transformed into issues of national importance from the Civil War to the present day. Individual conferences on assigned papers are required. Prerequisite: One year of United States history, political science, or sociology.

379. **Studies in American Racial History. 4 hours.** Seminar; emphasizes original research on selected topics of American racial history. Prerequisites: Hist. 377 and 378.

380. **Bourbon France from 1685 to 1789. 4 hours.** Political, social, economic, and intellectual history of France under the Bourbon monarchy from the reign of Louis XIV to the Revolution. Individual conferences on assigned papers are required. Prerequisite: Hist. 322.

381. **Greek History from 750 to 478 B.C. 4 hours.** Political, social, and economic development of Greece from the end of the Dark Ages to the defeat of the Persian invader. Prerequisite: Hist. 282.

382. **Greek History from 478 to 336 B.C. 4 hours.** Political, social, and economic development of Greece from the end of the Persian Wars to the Macedonian conquest. Individual conferences on assigned papers are required. Prerequisite: Hist. 282.

383. **The Roman Revolution from 146 to 30 B.C. 4 hours.** Political, social, and economic history of Rome from the Gracchan crisis to the end of the Republic. Prerequisite: Hist. 283.

384. **The Roman Empire, the Second Through the Sixth Centuries A.D. 4 hours.** The Roman Empire as a bridge between antiquity and medieval civilization. Decay of imperial institutions as a result of social tensions and economic problems and

attempts at imperial reform. Christianity in the empire and the rise of the papacy. The Germanic invasions and establishment of the Western kingdoms. Individual conferences on assigned papers are required.

385. **European Intellectual History: the Seventeenth Century. 4 hours.** Beginnings of the scientific revolution and its effect on the cosmology, theology, and philosophy of the Middle Ages. The Counter-Reformation, Jansenists, and Jesuits. Political theory, absolutism, natural law, republicanism. The battle of the ancients and moderns. Classicism and Baroque. Mysticism and the great philosophical systems. Individual conferences on assigned papers are required.

386. **European Intellectual History: The Age of Criticism from 1680 to 1750. 4 hours.** Newtonian synthesis and its impact on the eighteenth century. Attack on authority, Bayle, Vico, Locke, the English Deists. Growth of scepticism, David Hume. Formation of Enlightenment philosophy, Montesquieu, Voltaire, and the first *philosophes*. Scientific academies, the salons, and the development of liberalism. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor.

387. **European Intellectual History: The High Enlightenment from 1750 to 1799. 4 hours.** The Enlightenment synthesis. The problem of the Enlightenment. Materialism, mechanism, egoism, fatalism. The *Encyclopedia;* liberalism and the crusade against social injustice; Rousseau and the revolt against the Enlightenment; primitivism, sentiment, and the beginnings of Romanticism. The Enlightenment in Germany. Impact of the Enlightenment on the French Revolution. Prerequisite: Hist. 386.

388. **Greek and Roman Historiography. 4 hours.** Analysis of the most important historians of classical antiquity, including their backgrounds, motives, interests, techniques, prejudices, and philosophies of history. Prerequisite: Hist. 282 or 283.

389. **American Historians from 1607 to 1876. 4 hours.** Major American historians; analysis of their works as expressions of American culture. Emphasis on the role of history in American life and thought. Individual conferences on assigned papers are required.

390. **Proseminar on American History. 4 hours.** May be repeated for credit. Selected topics for special study. Individual conferences on assigned papers are required.

391. **American Historians from 1877 to the Present. 4 hours.** Major American historians; analysis of their works as expressions of American culture. Emphasis on the role of history in American life and thought. Individual conferences on assigned papers are required.

392. **Proseminar in Modern European History. 4 hours.** May be repeated for credit. Selected topics for special study. Individual conferences on assigned papers are required.

393. **Proseminar in East-European History. 4 hours.** May be repeated for credit. Selected topics for special study. Prerequisite: Consent of the instructor.

394. **Proseminar in English History. 4 hours.** May be repeated for credit. Selected topics for special study. Individual conferences on assigned papers are required.

395. **Proseminar in Medieval History. 4 hours.** May be repeated for credit. Selected topics for special study. Individual conferences on assigned papers are required.

396. **Proseminar in Russian History. 4 hours.** May be repeated for credit. Selected topics for special study. Individual conferences on assigned papers are required.

397. **Development of Modern France from 1815 to 1914. 4 hours.** Investigation into the major political and socioeconomic forces at work in French history from the fall of Napoleon to the First World War; both the uniqueness and the universality of the French experience are stressed. Individual conferences on assigned papers are required.

398. **Development of Modern France from 1914 to the Present. 4 hours.** Investigation into the major political and socioeconomic forces at work in French history from the First World War to General Charles de Gaulle's Fifth Republic; the uniqueness and the universality of the French experience are stressed. Prerequisite: Consent of the instructor.

399. **Topics in Modern French History. 4 hours.** A thematic approach to the major political, social, and economic forces in modern French history; revolution; the classes and the masses; Marxism; the military; bureaucracy; technocracy; political parties and ideologies; Gaullism. Prerequisite: Consent of the instructor.

INFORMATION ENGINEERING

Herbert J. Stein, Acting Head of the Department

Professors
James W. Dow, Philip Parzen

Associate Professors
Robert C. Arzbaecher, Kurt Burian, Earl E. Gose, Derek P. Hendry, Chathilingath K. Sanathanan, Herbert J. Stein, Arne Troelstra, Bert L. Zuber

Assistant Professors
John A. Campbell, Dan Censor, Yun-Leei Chiou, Roger C. Conant, John D. Ferguson, Chu Q. Lee, Miljenko Orsic, Howard Prosser, Devendar C. Reddy, Thomas M. Smith

The department offers a program leading to the Master of Science degree with areas of specialization in information engineering and bioengineering.

Specialization in information engineering allows a broad choice of topics, including circuit theory, electromagnetic field theory, communication theory, automatic control theory, solid state electronics, and computer science. This

program is similar to that in electrical engineering elsewhere and is offered for graduates of information engineering-oriented curricula at the University of Illinois at Chicago Circle and for graduates of electrical engineering or similar curricula elsewhere. Graduates of other scientifically oriented curricula may be admitted if they have the background to profit from graduate work in this field.

Specialization in bioengineering trains the student in the application of engineering concepts and methods to the life sciences and medicine. Areas covered include bioinstrumentation; the application of the principles of information, communication, and control to living systems; and studies in electrocardiography, pattern recognition, and behavior. This program is offered for graduates of life science, physical science, or engineering curricula. Students from the life sciences are expected to emphasize mathematics, engineering, and the physical sciences in their initial course work, and students from the physical sciences are expected to concentrate initially on the life sciences.

Admission Requirements

Applicants should have maintained a grade-point average of B (4.00) or better in the last 90 quarter hours of undergraduate work. Applicants with grade-point averages between 3.50 and 4.00 may be admitted upon special recommendation of the department. Practicing engineers wishing to return to school for further graduate instruction may be admitted on a tentative basis if their professional experience makes it appear likely that they will be able to succeed in the program. This tentative admission will be made permanent after the completion of at least sixteen quarter hours with a grade-point average of 4.00 or better.

Degree Requirements

A grade-point average of at least 4.00 is required for the degree of Master of Science. No credit is given for any course in which a grade of less than C has been obtained. For graduation, 48 quarter hours are required, with the following additional minimum requirements:

The successful completion of a thesis, research project, design project, or extensive reading assignment to be followed by a written report and an oral examination. For this the student will receive credit for at least four and not more than sixteen quarter hours.

The completion of at least twenty quarter hours (including thesis credit) in information engineering courses at the 400 level.

For those specializing in information engineering, Information Engineering 410 and 420.

For those specializing in bioengineering, completion of at least 28 hours in graduate courses in the College of Engineering.

Courses for Graduate Students

410. **Advanced Linear Analysis. 4 hours.** Analysis of linear networks and systems in the time and frequency domains. Basis of loop and node equations. Signal flow graphs, transform methods, state variable representation, stability. Prerequisites: InfE. 311 and credit or registration in Math. 330.

412. **Network Synthesis I. 3 hours.** Conventional methods of passive network synthesis. Positive real functions. Synthesis of LC, RC, RL, and RLC one-ports. Transfer function synthesis and insertion-loss synthesis. Prerequisites: InfE. 316 and credit or registration in Math. 330.

413. **Network Synthesis II. 3 hours.** Active network synthesis. Properties and practical realization of active and nonreciprocal network elements. Synthesis of active RC networks with NIC and controlled sources. Prerequisite: InfE. 412.

414. **Network Synthesis III. 3 hours.** Approximation methods of network functions in both frequency and time domain. Practical filter design. N-port network synthesis. Current topics on network synthesis. Prerequisite: InfE. 413.

415. **Network Topology. 4 hours.** Network theoretic graph theory; tree, incidence, circuit and cut-set matrices and their properties; topological analysis and synthesis of electrical and transport network; role of network topology in computer-aided network analysis and design. Prerequisite: InfE. 410.

420. **Electromagnetic Field Theory. 4 hours.** Transmission lines, guided waves, radiation from antennas. Prerequisites: InfE. 324 and credit or registration in Math. 330.

421. **Advanced Electromagnetic Field Theory. 4 hours.** Advanced study of electromagnetic field concepts, including uniqueness and reciprocity theorems, Huyghen's and Babinet's principles, reaction concept, variational methods, and applications to several coordinate systems. Prerequisite: InfE. 420.

422. **Advanced Microwave Theory. 4 hours.** General solution for fields in waveguides of arbitrary cross section. Microwave network analysis. Microwave devices, microwave cavities, and microwave filters. Prerequisite: InfE. 420.

423. **Antenna Theory and Design. 4 hours.** Theory and design of antennas and radiating systems. Analysis of linear, circular, and helical radiation elements. Reciprocity theorems. Antenna arrays. Slot, horn, and reflector type antennas. Prerequisites: InfE. 325 and 420.

430. **Advanced Communication Theory I. 4 hours.** Beginning graduate course in modern communication theory. Review of probability theory, random waveforms, optimum receiver principle. Prerequisite: InfE. 331.

431. **Advanced Communication Theory II. 4 hours.** Continues Information Engineering 430. Efficient signaling for message sequences and implementation of coded systems. Prerequisite: InfE. 430.

432. Advanced Communication Theory III. 4 hours. Continues Information Engineering 431. Channel models, filter-signal channel, bandpass channel, fading channel. Linear modulation, twisted modulation, frequency modulation, channel capacity, pulse-code modulation. Prerequisite: InfE. 431.

440. Solid State Device Theory. 4 hours. Study of electrical phenomena in solids, using quantum mechanics. Semiconductors, p-n junctions, transistors. Hall effect, thermal and optical effects. Prerequisites: InfE. 342 and Phys. 321.

441. Integrated Solid State Devices. 4 hours. Applications of solid state theory to modern integrated circuits. Active and passive semiconductors, active and passive functional blocks, MOS and thin film devices. Prerequisites: InfE. 316 and 440.

451. Advanced Biocontrol. 3 hours. Mathematical modeling and analysis of biological systems, emphasizing techniques of control engineering. Prerequisite: InfE. 353.

452. Advanced Biocontrol Laboratory. 3 hours. Laboratory experiments in conjunction with Information Engineering 451. Experience with control systems of pupil, eye movement, sensory motor coordination. Prerequisite: Credit or registration in InfE. 451.

460. Advanced Control Theory. 4 hours. Analysis of multivariable, multiloop control systems. Advanced topics in state space, time varying and distributed parameter systems, stability, controllability, and observability. Introduction to adaptive control. Various computer applications. Prerequisite: InfE. 361.

461. Nonlinear Control. 4 hours. Classification of nonlinear phenomena, linear and piecewise linear approximations. The describing function and on-off servomechanisms, phase plane techniques, limit cycle, stability concepts. Use of analog, digital, and hybrid computers for simulation. Prerequisite: InfE. 361.

462. Synthesis Techniques in Linear Control. 4 hours. Design principles. Cascade compensation using root locus, polar and log plots, feedback compensation. Applications in electrical, electromechanical, and fluid control. Mitrovic's parameter plane methods. Prerequisite: InfE. 361.

463. Statistical and Sampled Data Control. 4 hours. Basic principles of statistical design; random signals in a control system; properties of correlation function; optimality. Wiener-Hopf equation. Design of systems with constraints. Introduction to sampled data control; the sampling process; Z transform methods; stability, time and frequency response, compensation techniques. Prerequisites: InfE. 330 and 361.

470. Automata Theory. 4 hours. Definition and representation, equivalent states, congruence relations, decision problems of finite automata, the halting problem, state assignment problem, partitions, growing automata, probabilistic automata, self-repairing and self-reproducing systems. Prerequisite: InfE. 373.

471. Advanced Switching Theory. 4 hours. Principles of sequential circuit synthesis, structure of combinational switching circuits, the covering problem, multiple output and multilevel combinational circuits, bilateral switching networks, speed independent switching circuit theory. Prerequisite: InfE. 373.

472. **Hybrid Computation Theory and Techniques. 4 hours.** Basic characteristics of analog and digital computers, nature of problems best suited for analog, digital, and hybrid computers, organization of a hybrid computer, analog digital conversion, hybrid computing techniques with examples from different disciplines. Prerequisite: InfE. 373.

483. **Bioinstrumentation: Transducers. 4 hours.** Consideration of energy conversion, with detailed discussion of transducers used in biological research. Prerequisites: InfE. 240 and 311.

484. **Bioinstrumentation: Systems. 3 hours.** Analysis of systems used in biological and medical instrumentation. General principles and specific electrical, mechanical, and optical aspects of instrumentation systems. Prerequisite: InfE. 483.

495. **Individual Research. 2 to 8 hours.** May be repeated. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.

498. **Seminar in Bioengineering. 2 to 4 hours.** May be repeated. Systematic review of special topics; emphasis on current research. Prerequisite: Consent of the instructor.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Thesis work under the supervision of a graduate adviser.

Courses for Graduate and Advanced Undergraduate Students

311. **Linear Systems Analysis. 4 hours.** No graduate credit for majors in information engineering. Application of signal representations discussed in Information Engineering 212 to the analysis of linear systems; transform methods and frequency analysis; natural response, stability; signal flow graphs; Laplace transform with two variables; convolution integral and applications. Prerequisite: InfE. 212.

312. **Introduction to Communication Engineering. 4 hours.** Communication systems; amplitude, frequency, and pulse-type modulation; correlation and correlation functions; noise and noise calculations; channel capacity and bandwidth signal to noise ratio applications. Prerequisites: InfE. 311 and 340.

315. **Intermediate Network Analysis. 4 hours.** Laplace transform analysis of networks; impedance and admittance function, network theorems; network functions; one and two-port networks. Individual projects are required. Prerequisite: InfE. 311.

316. **Introduction to Network Synthesis. 4 hours.** Continues Information Engineering 315. Covers positive real functions, L-C synthesis, RC, RL, and RLC synthesis, and filter design. Individual projects are required. Prerequisite: InfE. 315.

320. **Introductory Wave Propagation and Transmission. 5 hours.** No graduate credit for majors in information engineering. Transmission line theory and introduction to waveguides; elementary antenna theory. Prerequisite: InfE. 221.

324. **Wave Propagation and Radiation I. 4 hours.** Maxwell's equations and electromagnetic waves. Analysis of wave propagation in rectangular and circular waveguides. Reduc-

tion of waveguide discontinuity problems to equivalent network problems. Prerequisites: InfE. 311 and 320.

325. **Wave Propagation and Radiation II. 4 hours.** Antennas and radiating systems. Radiation from a quarter-wave monopole or half-wave dipole. Antenna impedance. Directional characteristics of antennas. Antenna practice and design. Prerequisite: InfE. 324.

326. **Wave Propagation and Radiation III. 4 hours.** Motion of charged particles in fields. Principles of klystrons, magnetrons, and traveling wave tubes. Introduction to solid state parametric devices. Prerequisite: InfE. 325.

330. **Communication Theory I. 4 hours.** With Information Engineering 331, an introduction to statistical communication theory. Signal spectra, modulation, noise, probability theory; applications of statistics to communication systems; Prerequisite: InfE. 312.

331. **Communication Theory II. 4 hours.** Continues Information Engineering 330. Individual projects are required. Prerequisite: InfE. 330.

340. **Intermediate Electronics. 4 hours.** Continues Information Engineering 240. No graduate credit for majors in information engineering. Applications of tubes, transistors, and semiconductor diodes; practical laboratory experience. Prerequisite: InfE. 240.

342. **Solid State Electronics. 4 hours.** Semiconductor physics and semiconductor circuits. Physics and circuit properties of transistors, semiconductor diodes, and other semiconductor devices; practical laboratory experience. Prerequisite: InfE. 340.

344. **Electronic Applications I. 4 hours.** With Information Engineering 345, a discussion of devices and circuits involved in pulse, digital, and switching waveforms. Prerequisite: InfE. 342.

345. **Electronic Applications II. 4 hours.** Continues Information Engineering 344. Prerequisite: InfE. 344.

352. **Biocontrol. 3 hours.** Demonstration of the applicability of the control systems theory to physiological systems including the pupil system, eye and hand movement systems, and utilizing techniques such as Fourier analysis, Nyquist stability criteria and cross-correlation. Prerequisite: InfE. 311.

353. **Biocontrol Laboratory. 3 hours.** Experimental counterpart of Information Engineering 352. Motor coordination, crayfish photoreceptor, human pupil, eye movement. Prerequisite: Credit or registration in InfE. 352.

360. **Automatic Control Theory I. 4 hours.** Introductory mathematical preliminaries of control systems. Concept of feedback; transfer functions of typical electrical, mechanical, and hydraulic control systems; state variable representation of systems; signal flow graphs; implications of feedback on system performance; time domain analysis; stability concepts including Lyapunov, Routh-Hurwitz, and Nyquist stability criteria. Laboratory assignments include experimental determination of the

response of typical control systems and analog computer simulations. Prerequisite: InfE. 311 or SysE. 312.

361. **Automatic Control Theory II. 4 hours.** Continues Information Engineering 360. Introduction to the design of feedback control systems, frequency response methods, root locus, Nichols chart, compensation techniques; modern control theory, matrix representation of linear systems and mode interpretations, concepts of controllability and observability; and linear time-varying systems. Projects involving intensive studies on servo systems and extensive simulations on digital or analog computers. Prerequisite: InfE. 360.

371. **Computer Structure and Language. 4 hours.** Computer structure and machine language, addressing techniques, components and circuits to execute the machine language instructions, digital representation of data, symbolic coding and programming techniques, computer system organization. Prerequisites: InfE. 340; Math. 195 and 340.

372. **Discrete Mathematics in Computer Design. 3 hours.** Basic set algebra, algebraic structures, Boolean algebra and propositional logic, and their applications to the design of switching circuits, graph theory, and applications. Prerequisite: InfE. 371.

373. **Switching Theory and Applications. 3 hours.** Nondecimal number systems; error correcting and other codes, analysis of gating components and networks, truth tables, combinational networks, threshold logic, regular expressions, synthesis of sequential circuits, iterative and symmetric network. Prerequisite: InfE. 372.

379. **Real-Time Data Processing. 4 hours.** Theory and techniques of data processing using analog and digital computers. Emphasis on the unique computational problems presented by biological data, illustrating the practical use of communication theory. Prerequisites: Math. 195 and 220.

391. **Seminar. 1 to 4 hours.** Topics to be arranged. Prerequisite: Consent of the instructor.

393. **Special Problems. 2 to 4 hours.** May be repeated for credit. Special problems or reading by arrangement with the faculty. Prerequisite: Consent of the instructor.

MATERIALS ENGINEERING

Professors
Ernest F. Masur, Head of the Department; Thomas H. Blewitt, David W. Levinson, William Rostoker, John A. Schey, Robert L. Schiffman

Associate Professors
Robert F. Domagala, James M. Doyle, Gordon H. Geiger, Walid ᴴ. Rimawi, Daniel F. Schoeberle, Albert B. Schultz, Surendra P. Shah, Thomas C. T. Ting, Otto E. Widera

Assistant Professors

Ted B. Belytschko, Robert H. Bryant, Yao W. Chang, Mahmoud Khojasteh, Charles A. Moore, Chien H. Wu

Lecturers

Donald G. Lemke

The department offers a program leading to the degree of Master of Science in Mechanics and Materials. Jointly with the Department of Energy Engineering it offers a program leading to the degree of Doctor of Philosophy in Engineering (Solids and Fluids).

The M.S. program covers a broad range of topics and may be used either as a terminal program for those planning to seek employment after obtaining the degree or as a basis for further studies. The courses offered within this program are relevant to many professional disciplines. Because of extensive freedom in course selection, a student may prepare himself for a career in such diverse areas as metallurgy, soil mechanics and foundations, structures (including concrete technology), and engineering mechanics. Interdisciplinary programs are permitted and encouraged.

After admission to the Graduate College the student is assigned a departmental adviser with whom a tentative course program is planned. This may be revised periodically in consultation with the adviser. Moreover, the student is free to change his adviser if he feels that such a change may be useful in the pursuit of his particular specialty.

The department does not have prescribed study programs or required courses. The selection of courses is therefore entirely up to the student and his adviser; however, satisfaction of the degree requirements needs departmental approval.

The joint Ph.D. program presently includes the following areas of specialization: continuum mechanics, gas dynamics, heat transfer, metallurgy, plasma dynamics, soil engineering, and structures. Of these, the Department of Materials Engineering specializes in courses in the fields of continuum mechanics, metallurgy, soil engineering, and structures. Students are permitted and encouraged to follow interdisciplinary programs which may include more than one area of specialty and may require taking courses in more than one department.

Admission Requirements

Graduates from recognized engineering colleges will be admitted if they have maintained a grade-point average of B (4.00) or better in undergraduate study. Those with lower averages may be admitted upon recommendation of the department, providing they satisfy the minimum requirements of the Graduate College. Practicing engineers wishing to return to school for graduate instruction

may be admitted on a tentative basis if their professional experience makes it appear likely that they will be able to follow the program successfully. This tentative admission will become permanent after the completion of at least 16 quarter hours with an average of 4.00 or better.

Degree Requirements

A grade-point average of at least 4.00 is required. Credit toward a graduate degree is not given for any course in which a grade of less than C has been obtained.

Master of Science

Forty-eight quarter hours are required; of these at least 16 must be in courses at the 400 level. Because of the diversity of the departmental offerings and areas of concentration the department does not prescribe any specific courses. However, in order to insure adequate breadth, the following distribution is required:

At least two courses in mathematics.

At least two courses (other than those in mathematics) outside the student's area of specialization. It may often be desirable to take these two courses outside the Department of Materials Engineering.

The satisfaction of these distribution requirements is subject to departmental verification.

The student may, at his discretion and in consultation with his adviser, elect to take up to 12 hours of Materials Engineering 499, Thesis Research. In order to obtain credit he has the following options:

a. For 1 to 4 hours of credit — a report on his work to be evaluated by his adviser.

b. For 5 to 8 hours of credit — a report on his work to be evaluated by a departmental committee.

c. For 9 to 12 hours of credit — a thesis based on original work.

Doctor of Philosophy

In order to become a candidate for the doctorate, a student must pass the departmental qualifying examination. If a student is working toward his Master's degree, he should take this examination after completion of at least 36 quarter hours of course work. If he has obtained his M.S. elsewhere, he should take the examination within one year after being admitted as a graduate student at Chicago Circle.

After a student becomes a candidate for the doctorate, he will be assigned a

faculty committee to plan and supervise his course program. Approximately 48 quarter hours of course work past the M.S. (or the equivalent) are required. There are no specific course requirements. However, at least two courses must be taken in the Department of Energy Engineering. Moreover, interdisciplinary and interdepartmental programs involving other departments, especially the Department of Energy Engineering, are encouraged. Toward the end of his course work the student is required to pass a preliminary examination administered by a faculty committee.

A major requirement of the Ph.D. program is the completion of a thesis based on a program of original research, which is carried out and written under the supervision of a faculty committee of at least five members. The thesis must be defended before the committee and the public in an examination, notice of which appears in an official campus publication.

The number of credit hours required for the doctoral thesis is not fixed and is adjustable in accordance with the regulations of the Graduate College. Although formal thesis research often does not start until completion of the preliminary examination requirements, it is also common to initiate an informal research program while the student is still involved in course work.

Reading proficiency in one foreign language is required. The language must be French, German, or Russian, unless the student is able to demonstrate to the department that a sufficient body of literature in his field of study exists in a substitute language. The language requirement is satisfied by passing the E.T.S. foreign language examination, by completing language courses with a grade of at least B, or by translating a technical paper selected by the department.

Courses for Graduate Students

401. **Continuum Mechanics. 4 hours.** Kinematics and dynamics of continua. Conservation principles, constitutive relations. Approximations. Prerequisite: MatE. 301.

402. **Applied Elasticity II. 4 hours.** Development of classical plate equation and boundary conditions; solution of problems in rectangular and polar coordinates; energy principles; plates with variable thickness; large deflection theory; effect of shear deformations. Prerequisite: MatE. 302.

403. **Theory of Elasticity II. 4 hours.** Review of complex variable theory, application to torsion, bending, and plane problem. The general three-dimensional problem, stress functions, singularities. Introduction to elastokinetics. Prerequisite: MatE. 303.

404. **Plasticity I. 4 hours.** Basic postulates of plasticity, Yield conditions and associated flow laws. Torsion of cylindrical and prismatic bars. Generalized stresses and strain rates. Theorem of limit analysis. Application of limit analysis to plane problems, plates, and shells. Prerequisite: MatE. 301.

406. **Theory of Shells. 4 hours.** Differential geometry; geometry of deformation; equations

of equilibrium; energy theories; membrane theory; general bending theory. Application to shells of different geometry. Prerequisites: MatE. 302 and Math. 322.

408. **Theory of Viscoelasticity. 4 hours.** Establishment of the field equations of visco-elastic materials and mathematical techniques of solving these equations. Prerequisites: MatE. 303 and Math. 322.

411. **Vibrations of Structural Elements. 4 hours.** Analytic and numerical treatment of vibrations in elastic strings, beams, plates, etc. Prerequisites: MatE. 302 and Math. 322.

412. **Vibrations and Waves in Solids. 4 hours.** Mathematical and experimental treatment of waves in elastic and inelastic solid media. Prerequisites: MatE. 303 and Math. 322.

421. **Structural Analysis III. 4 hours.** Application of matrix, numerical, and computer techniques to the analysis of complex structural systems. Prerequisite: MatE. 321 or the equivalent.

422. **Mechanics of Reinforced Concrete. 4 hours.** Introduction to composite materials; properties of steel, concrete, and the bond between steel and concrete. Elastic, inelastic, and post-failure behavior of reinforced concrete members. Effects of continuity. Effects of time. Probabilities of uncertainties of materials and loadings. Analysis of design codes. Prerequisite: MatE. 322.

423. **Elastic Instability I. 4 hours.** Principles of elastic instability and their analytical, numerical, and experimental treatment. Buckling of columns, frames, rings. Lateral and torsional instability. Prerequisite: MatE. 302. A knowledge of partial differential equations is required.

424. **Elastic Instability II. 4 hours.** General discussion: small displacements superimposed on finite deformations; application to plates and shells; post-buckling analysis; dynamic instability. Prerequisite: MatE. 423. A knowledge of partial differential equations is required.

432. **Dislocation Theory. 4 hours.** Nature of dislocation in crystals. Static and dynamic behavior. Interaction with solute atoms, precipitates, and other dislocations. Effect on mechanical properties. Dislocation interactions, reductions, and dislocation arrays. Prerequisite: MatE. 301.

433. **Advanced Mechanical Metallurgy. 4 hours.** Mechanical flows of metals and alloys from the standpoint of continuum mechanics. Application to basic metal-forming operations. Prerequisite: MatE. 301.

434. **Advanced Experimental Methods. 4 hours.** First of two courses covering the theoretical and operational aspects of advanced materials research methods at an advanced level. Design of complex experimental devices. Applications and limitations. Treatment of data. Prerequisite: MatE. 230.

441. **Mechanics of Multiphase Systems. 4 hours.** Three-dimensional theory of multiphase media including effects of applied forces, thermo-osmosis, electro-osmosis, and chemical potentials. Three-dimensional theory of consolidation; derivation, solution

by analytical and numerical means. Analysis of three-dimensional consolidation effects. Prerequisites: MatE. 301 and 341.

442. **Strength and Deformation Theories of Soil. 4 hours.** Theories of plasticity as applied to soil mechanics. Problems of limiting equilibrium. Application of plasticity theories to problems of bearing capacity, earth pressure, and slope stability. Mechanics of granular systems. Prerequisites: MatE. 301 and 341. A knowledge of partial differential equations is required.

447. **Advanced Soil Engineering I. 4 hours.** Analysis of displacements of structures due to earth deformation. Site exploration; analysis of foundation types; shallow and deep foundations; settlements; bearing capacity. Retaining structures. Prerequisite: MatE. 261.

461. **Advanced Deformation Processing I. 4 hours.** Fundamental aspects of yielding and ductile failure in important deformation modes. Deformation of crystal aggregates and development of textures. Metallurgical changes during deformation. Effect of plastic flow on basic friction processes. Prerequisite: MatE. 360.

462. **Advanced Deformation Processing II. 4 hours.** Interactions between workpiece and equipment. Dynamic response of system. Design of process around material. Experimental techniques. Prerequisite: MatE. 461.

463. **Fundamentals of Friction, Lubrication, and Wear. 4 hours.** Measurement and theories of friction. Adhesion between similar and dissimilar material pairs. Mechanisms of wear. Boundary, thin film, hydrodynamic and elastohydrodynamic lubrication. Prerequisite: MatE. 230.

464. **Embrittlement Phenomena. 3 hours.** Physical characteristics of cracking originating from temperature, microstructure, and environment. Theories of the origins of embrittlement. Prerequisite: MatE. 252.

465. **Advanced Metallurgical Thermodynamics. 4 hours.** Treatment of multicomponent system thermodynamics with emphasis on metallurgical process applications. Development of relation between structure of metallic solutions, molten salts, and quasi-chemical models. Introduction to the relations between defects in nonmetallic crystals and the gas-phase composition. Prerequisite: EnrE. 305.

493. **Special Problems. 1 to 4 hours.** Special topics, seminars, or other special activities.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Individual research: reading, design, analytical studies, or laboratory assignments. Culminates in report, Master's thesis, or Ph.D. thesis. Examination of report or thesis required.

Courses for Graduate and Advanced Undergraduate Students

301. **Introduction to the Mechanics of Continua. 4 hours.** Vectors and tensors and their component properties in Cartesian coordinates. The displacement and velocity vectors, the stress and strain tensors and their time rates. Isotropic and deviatoric components. Equations of equilibrium and of compatibility. Constitutive relations

for linear elastic and viscous bodies and generalized linear viscoelastic behavior. Isotropy. Introduction to perfect plasticity. Sample problems for all cases by means of simple one-dimensional models. Prerequisites: MatE. 103 and Math. 220.

302. **Applied Elasticity I. 4 hours.** Variational theorems of elasticity theory. Application to establishment and solution of approximate systems; beams (including shear deformations) and plates. Introduction to instability theory. Prerequisite: MatE. 205 or 206.

303. **Theory of Elasticity I. 4 hours.** The boundary value problems of linear isotropic elasticity theory. Uniqueness of solution. Reduction to two dimensions: the plane problem, torsion, bending. General orthogonal coordinates and special application to polar coordinates. Three-dimensional problems with axial symmetry. Prerequisite: MatE. 301.

304. **Experimental Stress Analysis. 4 hours.** Structural similitude and dimensional analysis. Brittle coating. Introduction to photoelasticity. Strain measurement techniques. Prerequisite: MatE. 206.

311. **Intermediate Dynamics. 4 hours.** Kinematics of a point; space curves. Particle dynamics, orbital motion, and stability. Moving reference frames. Rigid body dynamics: the inertia tensor, Euler's equations, application to gyroscopic motion. Hamilton's principle. Generalized coordinates. Lagrange's equations. Prerequisites: MatE. 102 and Math. 220.

312. **Nonlinear Oscillations. 4 hours.** Exact and approximate methods of studying vibrations of nonlinear systems. Analytical and graphical techniques. Forced oscillations, self-excited systems, stability criteria. Computer methods. Practical applications. Prerequisite: MatE. 208.

313. **Applied Dynamics. 4 hours.** Application of principles of dynamics to engineering physics. Balancing; rolling and sliding contact, static and dynamic force analyses of machine elements. Critical speeds. Impact loading. Prerequisite: MatE. 311.

321. **Structural Analysis II. 4 hours.** Establishment of basic equations governing linear structural systems. Matrix inversion and relaxation solutions. Approximate analyses. Introduction to dynamics of structures. Prerequisite: MatE. 207.

322. **Concrete Technology I. 4 hours.** Relations between microproperties and macroproperties; mechanisms of fracture, creep, and shrinkage; statistical aspects; air entrainment; special types of concrete. Individual research project involving laboratory and analytic techniques. 3 hours, lecture; 2 hours, laboratory. Prerequisite: MatE. 203 or the equivalent.

324. **Limit Analysis and Design of Structures. 4 hours.** Boundedness principles of perfect plasticity. Application to analysis and design of structures. Prerequisite: MatE. 207.

331. **Electron Theory of Metals. 3 hours.** Modern physical concepts of metals and alloys. Introduction to wave mechanics. Thermal, electrical, and magnetic properties of metals. Band theory of metals. Prerequisite: MatE. 252.

332. **Advanced Diffraction Analysis. 3 hours.** Single crystal methods in X-ray diffraction,

orientation determination, pole figures, structure determination, precision lattice constant methods. Prerequisite: MatE. 239 or the equivalent.

333.   **Design Use of Materials. 4 hours.** Extreme value statistics, mechanical effects of a notch, fracture mechanics, fatigue, stress rupture, residual stress effects, and relationships to design performance. Prerequisite: MatE. 230.

334.   **Metallurgy of Nuclear Materials. 3 hours.** Uses of materials for the production of nuclear energy, environmental problems associated with radiation damage, mechanical and physical property changes, swelling, poisoning, fission, moderation, neutron capture, and latent activity. Prerequisites: MatE. 252 and Phys. 114.

335.   **Electron Microscopy. 3 hours.** The electron microscope and its application to the study of surface replicas and thin films of metals, alloys, and other materials. Sources of contrast. Selected area diffraction. Prerequisites: MatE. 239 and 252.

337.   **Process Metallurgy of Iron and Steelmaking. 4 hours.** Physicochemical principles applied to reduction, conversion, and refining of steel and ferrous alloys. Applications of thermodynamics to equilibrium problems such as slag-metal equilibria, and applications of process engineering principles to the dynamic behavior of various component systems such as sinter plants, blast furnaces, and basic oxygen furnaces. Prerequisite: MatE. 243.

341.   **Theoretical Soil Mechanics I. 3 hours.** Theories used in soil mechanics. Derivation of theoretical relationships and theoretical implications of empirical laws. Theories of deformation of soil systems; states of stress and deformation in soil masses; one-dimensional theory of consolidation for homogeneous and nonhomogeneous clay layers; seepage as a function of isotropy and homogeneity. Prerequisite: MatE. 262 or the equivalent.

342.   **Theoretical Soil Mechanics II. 4 hours.** Stresses and displacements in earth masses. The analysis of layered systems: analytical, finite difference, finite element methods. Settlement analysis: soil-structure interaction. Analysis of structural response of flexible and rigid pavements. Development of problem-oriented computer languages for settlements. Prerequisites: MatE. 341 and Math. 322.

343.   **Theoretical Soil Mechanics III. 4 hours.** Seepage through earth masses: derivation of basic equations; analytical and numerical methods of solution; rapid drawdown. Stability of earth slopes; derivation of basic relationships; methods of Fellenius, Bishop, Morganstern. Computer methods for slope stability and seepage; problem-oriented languages. Prerequisite: Math. 322.

344.   **Physical-Chemical Principles of Soil Behavior I. 4 hours.** Clay mineralogy, soil formation and composition, sedimentation, mineral identification, colloidal phenomena in soils. Prerequisite: MatE. 260.

345.   **Physical-Chemical Principles of Soil Behavior II. 4 hours.** Swelling, ion association, soil-water analysis of mechanical behavior of soils in terms of physiochemical principles, and conduction phenomena. Prerequisite: MatE. 344.

346.   **Physical-Chemical Principles of Soil Behavior III. 4 hours.** Deformation mechanisms

and strength, compaction, frost action, rate processes such as secondary compression, creep, thixotropy. Prerequisite: MatE. 345.

360. **Deformation Processing. 4 hours.** Principles of deformation processes. Basic methods of problem solving. Practices and process control. Relations between processing and finished properties. Prerequisite: MatE. 230.

361. **Deformation Processing Laboratory. 1 hour.** Measurement of flow stress and formability. Effect of friction in forging, rolling, and deep drawing. Limiting reductions, optimum die angles in drawing. Effect of plastic anisotropy in deep drawing. Prerequisite: MatE. 360.

362. **Powder Metallurgy. 3 hours.** Physical attributes of fine powders. Mechanics of pressing. Theories of solid state sintering. Liquid phase sintering. Manufacturing aspects. Prerequisite: MatE. 230.

384. **Metallurgical Process Design. 3 hours.** Design and optimization of chemical and mechanical metallurgical processing systems. Process modeling and analysis. Direct search linear and dynamic programming solutions of process problems. Economic analysis and investment strategy. Prerequisite: MatE. 243.

391. **Seminar. 1 hour.** Topics to be arranged. Prerequisite: Consent of the instructor.

393. **Special Problems. 2 to 4 hours.** Special problems or reading by special arrangement with the faculty. Prerequisite: Consent of the instructor.

MATHEMATICS

Professors
Joseph Landin, Head of the Department; Harold W. Bailey, Norman Blackburn, Herbert J. Curtis, Flora Dinkines, Philip Dwinger, Irwin K. Feinstein, Paul Fong, Evelyn Frank, Henry L. Garabedian, Victor Gugenheim, Norman T. Hamilton, Noboru Ito, Louis L. Pennisi, Reuben I. Sandler, William F. Stinespring, Victor Twersky

Associate Professors
Furio Alberti, Warren H. Brothers, Djairo DeFigueiredo, David A. Foulser, Christoph H. Hering, William A. Howard, Shmuel Kantorovitz, Richard J. Milgram, James W. Moeller, Pramod K. Pathak, Neil W. Rickert, Alexander P. Stone, Avrum I. Weinzweig

Assistant Professors
Ruth M. Ballard, Neil Berger, James A. Donaldson, Verena H. Dyson, Gerald L. Gordon, Louis I. Gordon, Brayton I. Gray, Morton E. Harris, Melvin L. Heard, William M. Kantor, Carol M. Knighten, Robert L. Knighten, Richard Larson, Sim

Lasher, Jeff E. Lewis, Alan McConnell, Arthur Pu, Lena C. Pu, Yao-chun Rickert, Yoram Sagher, David M. Segal, Gary M. Seitz, Robert I. Soare, Alexander Zabrodsky, Leo F. Ziomek.

The department offers graduate work leading to the degrees of Master of Arts or Master of Science in mathematics, the Master of Science in the teaching of mathematics, and the Doctor of Philosophy in mathematics.

Admission Requirements

Applicants must have a grade-point average of 3.75. The average is computed from the last 90 quarter hours of work completed, including undergraduate and graduate courses. Students with averages below 3.75 but above 3.50 are considered on an individual basis. An applicant must also have a 4.00 average in all mathematics courses beyond calculus.

Students should have 30 quarter hours of undergraduate work in mathematics besides the usual beginning courses in algebra, trigonometry, analytic geometry, and calculus. For the Master's degree in mathematics these 30 hours must include one year of work in analysis (equivalent to Mathematics 310, 311, 312) and one year of work in an introduction to higher algebra (equivalent to Mathematics 340, 341, 342). The remaining hours should be in mathematics courses at the 300 level (or their equivalents). For the Master's degree in the Teaching of Mathematics, Mathematics 310, 340, 341, and either 342 or 348 (or the equivalent) are required for admission.

Applicants are required to take the Graduate Record Examination (Verbal, Quantitative, and Advanced) and to submit three letters of recommendation from persons familiar with their academic work. If a candidate is admitted with deficiencies in courses normally required for admission, he must remove such deficiencies during the first three quarters of his attendance. No graduate credit is given for such courses. A student who has done graduate work at a recognized institution may petition to receive credit for such work.

Degree Requirements

Master of Arts and Master of Science in Mathematics

Forty-eight quarter hours are required for the degree. Of these at least 36 must be in mathematics; at least 20 of the 36 hours must be in approved 400-level courses. The candidate must pass a written examination in the following areas of mathematics: point set topology, real variable, complex variable, elementary number theory, elementary group theory, linear algebra. A thesis is not required.

Master of Science in the Teaching of Mathematics

A candidate must earn 24 quarter hours in mathematics, 12 in education or psychology, and 12 in electives. He must have completed Mathematics 311, 312, and 342. The requirement in psychology may be satisfied by taking 12 quarter hours from the following: Psychology 317, 323, 351, 354, 355, or 382. When the College of Education offers appropriate courses, the requirements in psychology and in education may be met by such courses. The electives may be in mathematics, in education, in psychology, or (in exceptional cases) in other fields.

The advisers for candidates for this degree are Professors Irwin K. Feinstein and Alice Hart.

Doctor of Philosophy

Candidates for the doctorate who enter with a Master's degree from another institution or who received a Master's degree from the University of Illinois at Chicago Circle before the Master's examination was required for that degree are required to pass a qualifying examination. A candidate who has not passed this examination within one year of his admission will be dropped from the program. In exceptional circumstances the department may relax this time limit.

The student will choose a major subject from the following: algebra, analysis, applied mathematics, geometry, logic, probability and statistics, or topology. He must also choose two internal minors from the preceding list or one internal minor and one outside minor or a full outside minor. The choice of an outside minor must have the approval of the Department of Mathematics. The requirements for such a minor should be checked with the department concerned. The student will present at least 60 quarter hours in 400-level mathematics courses, unless he has chosen a full outside minor which requires 48 hours. At least three 400-level courses are required for each internal minor. Courses must have the approval of the department. Each student is required to have 144 hours of graduate credit, of which 48 hours will usually be thesis credit.

Shortly before the completion of 96 hours of graduate course work the student should select an adviser to direct a thesis in his major area of interest. As soon as possible thereafter, the student must take a preliminary examination. The purpose of this examination is to determine that the student is prepared to undertake a doctoral research program. The exact point in the student's career that the preliminary examination must be taken is not rigidly fixed, but the department will normally drop a student who has not passed the preliminary examination within one year of completion of the 96 hours of course work. In exceptional circumstances the department may relax this time limit. The examination will be based on the student's major and minor subjects and will consist of written examinations in the major and minor areas to be followed by

an oral examination in the major area if the written part is satisfactory.

The student must demonstrate reading proficiency in any two of the following languages: French, German, or Russian.

Since the doctoral program is intended to be training in mathematical research and scholarship, the crucial effort is the production of a thesis. With the guidance of the department the student will write a thesis that is a significant piece of mathematical research acceptable to the department.

Courses for Graduate Students

401. **Second Course in Abstract Algebra I.** 4 hours. Isomorphism theorems, permutation groups, finite groups, Sylow's theorems, structure of finitely generated Abelian groups, composition series, solvable groups. Prerequisite: Math. 342 or the equivalent.

402. **Second Course in Abstract Algebra II.** 4 hours. Field extensions, finite fields, Galois theory, Wedderburn's theorem. Prerequisite: Math. 401.

403. **Second Course in Abstract Algebra III.** 4 hours. Rings and algebras, structure of algebras, multilinear algebra, tensor products. Prerequisite: Math. 402.

404. **Rings and Modules.** 4 hours. The category of R-modules, projective and injective modules, the Morita theorems, elementary homological algebra, separable algebras, homological dimension. Prerequisite: Math. 403.

405. **Finite Groups.** 4 hours. Transfer theorems, p-nilpotent groups, E_π, C_π, D_π properties, solvable groups, Schur-Zassenhaus theorem, additional topics selected by the instructor. Prerequisite: Math. 403.

406. **Free Groups and Universal Properties.** 4 hours. Universal algebras, words and varieties, free algebras, free groups, subgroups of free groups, free products, free associative algebras, Birkhoff-Witt theorem, free Lie algebras. Prerequisite: Math. 403.

407. **Representation Theory.** 4 hours. Representation theory of finite-dimensional algebras, structure of the regular representation, characters, applications to finite groups, theorems of Frobenius and Burnside, character ring, exceptional characters. Prerequisite: Math. 403.

408. **Homological Algebra I.** 4 hours. Abstract categories and functors, adjoints, additive and Abelian categories, functor categories. Prerequisite: Math. 403.

409. **Homological Algebra II.** 4 hours. Complexes, homology, projectives and injectives, connected sequences of functors, satellites, derived functors, ext, tor, the full embedding theorem. Prerequisite: Math. 408.

410. **Nonassociative Algebras I.** 4 hours. Introduction to nonassociative algebras, alternative algebras, power associative algebras, Jordan algebras. Prerequisite: Math. 403.

411. Nonassociative Algebras II. 4 hours. Jordan algebras continued, Lie algebras, general classification theorems. Prerequisite: Math. 410.

419. Advanced Topics in Algebra. 4 hours. May be repeated for credit. Special topics in algebra. Prerequisite: Consent of the instructor.

421. Algebraic Topology I. 4 hours. The category of topological spaces and functors, homology of complexes, singular homology theory, Eilenberg-Steenrod axioms, C-W complex, cohomology and cup-products, universal coefficient theorem. Kunneth theorem. Prerequisites: Math. 342, and 357 or the equivalent.

422. Algebraic Topology II. 4 hours. Homotopy groups, Hurewicz theorem, Whitehead theorem, fiber spaces, Postnikov sections, obstruction theory, Serre spectral sequence, e-theory, applications. Prerequisite: Math. 421.

423. Algebraic Topology III. 4 hours. Freudenthal suspension theorem, stable homotopy theory, cohomology operations, construction and cohomology of Eilenberg-MacLane spaces, structure of the Steenrod algebra, Adams spectral sequence. Prerequisite: Math. 422.

429. Advanced Topics in Topology. 4 hours. May be repeated for credit. Special topics in topology. Prerequisite: Consent of the instructor.

430. Real Analysis I. 4 hours. Set theory, well-ordering cardinal and ordinal numbers, metric spaces, connectedness, compactness, completeness. Prerequisite: Math. 312.

431. Real Analysis II. 4 hours. Riemann Stieltjes integral and its extension, measures and measurable sets, measurable functions, the Lebesque integral. Prerequisite: Math. 430.

432. Real Analysis III. 4 hours. Function spaces, differentiable and nondifferentiable functions, absolutely continuous functions. Prerequisite: Math. 431.

433. Integral Equations. 4 hours. Fredholm and Hilbert-Schmidt theory and applications, symmetric kernels and orthogonal systems of functions, some types of singular and nonlinear integral equations. Prerequisite: Math. 312.

434. Transform Methods. 4 hours. Mellin and Hankel transforms, multiple Fourier transforms; applications to conduction of heat in solids, to slowing down of neutrons in matter, and to atomic and nuclear physics. Prerequisite: Math. 312, and 331 or 333.

435. Calculus of Variations. 4 hours. Introductory problems; geodesics, the brachistochrone, minimal surface of revolution. Isoperimetric problems. Geometrical optics, Fernat's principle. Dynamics of particles. Minimum characterization of the eigenvalue-eigenfunction problem. Ritz's method of approximation. Prerequisite: Math. 312.

436. Functional Analysis I. 4 hours. Topological vector spaces, Banach spaces, Hilbert spaces, Hahn-Banach theorem, interior mapping principle, uniform boundedness principle, applications, approximation and closure theorems. Prerequisite: Math. 432.

437. **Functional Analysis II. 4 hours.** Linear operators on a Banach space, the spectrum and resolvent of a linear operator, compact operators, spectral theorem for compact Hermitian operators on a Hilbert space, integral equations, Sturm-Liouville theory. Prerequisite: Math. 436.

438. **Functional Analysis III. 4 hours.** Spectral theorem for normal operators on a Hilbert space, unbounded operators, semigroups of linear operators, ergodic theorems. H^p spaces of analytic functions, Beurling's theorem on the shift operator, applications. Prerequisite: Math. 437.

449. **Advanced Topics in Analysis. 4 hours.** May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.

450. **Projective Geometry I. 4 hours.** Coordinatization, collineation groups, Desargues' condition, weakened forms of Desargues' condition and corresponding coordinate systems, fundamental theorem of projective geometry. Prerequisite: Consent of the instructor.

451. **Projective Geometry II. 4 hours.** Finite planes, free planes, collineations of division ring planes and of free planes, the Lenz-Barlotti classification. Prerequisite: Math. 450.

452. **Differential Geometry I. 4 hours.** Manifolds, tensor fields, the tensor algebra, the Grassman algebra, exterior differentiation, mappings, transformations of vector fields and differential forms, affine connections, parallelism, the exponential mappings, covariant differentiation. Prerequisite: Consent of the instructor.

453. **Differential Geometry II. 4 hours.** The Riemannian connection, complete Riemannian manifolds, isometries, curvature, Lie groups. Prerequisite: Math. 452.

454. **Structure of Differentiable Manifolds I. 4 hours.** Tangent bundle, vector fields, tensors, differentiable mappings, geodesics, exponential mapping, Whitney embedding theorem, Morse theory. Prerequisites: Credit or registration in Math. 421 and 430.

455. **Structure of Differentiable Manifolds II. 4 hours.** De Rham theorem, duality, vector bundles, characteristic classes, Hirzebruch index theorem, almost complex structures, Milnor spheres. Prerequisite: Math. 454.

456. **Structure of Differentiable Manifolds III. 4 hours.** Poincare conjecture, structures on manifolds, cobordism theorem, embeddings and immersions, Atiyah-Singer index theorem, Lie groups and Lie algebras, Bott periodicity theorem. Prerequisite: Math. 455.

459. **Advanced Topics in Geometry. 4 hours.** May be repeated for credit. Special topics. Prerequisite: Consent of the instructor.

460. **Numerical Methods in Partial Differential Equations I. 4 hours.** Classification of equations and boundary value problems; finite difference analogues for parabolic, hyperbolic, and elliptic equations; explicit and implicit methods of parabolic and hyperbolic systems; the method of characteristics for hyperbolic equations; stability of initial value problems; iterative methods (modern and classical) for elliptic

equations; discredization and round-off errors. Prerequisites: Math. 323 and 389 or the equivalents.

461. **Numerical Methods in Partial Differential Equations II. 4 hours.** Continues Mathematics 460. Prerequisite: Math. 460.

465. **Approximation Theory. 4 hours.** General approximation theory in normed linear spaces with primary emphasis on functions defined on an interval and periodic function; existence and uniqueness theorems; characterization of Chebyshev approximants; degree of approximation; use of approximations in computing. Prerequisites: Math. 312, and 342 or 348, or the equivalents.

470. **Probability Theory I. 4 hours.** Measure-theoretic aspects of probability theory, characteristic functions, the inversion theorem, the Levy-Cramer continuity theorem, Bochner's theorem, Cramer's theorem and the Herglotz lemma, types of convergence, the Borel-Cantelli lemma, the zero-one law, the law of large numbers, central limit theorems of Lindeberg, Liapunov, and Lindeberg-Feller. Prerequisite: Math. 432.

471. **Probability Theory II. 4 hours.** The central limit problem, conditional probability, martingales, random walk and recurrent events, Markov processes with discrete and continuous parameters, general introduction to processes with independent increments and orthogonal increments, stationary processes, least square prediction. Prerequisite: Math. 470.

480. **Scattering Theory I. 4 hours.** Solutions of the reduced wave equations for scattering of scalar, vector, and dyadic waves; separable and nonseparable problems. Representations: Green's function integrals, complex integrals, inverse distance series, special function series; approximations; geometrical optics and potential theory; applications. Prerequisites: Math. 323, 331, and Phys. 371.

481. **Scattering Theory II. 4 hours.** Representations, theorems, and approximations for many-body problems. Multiple scattering solutions as functionals of single-body functions: integral equations, algebraic equations, series representations, operational closed forms, asymptotic forms. Two-scatterer problems, arbitrary configurations, and periodic sprays. Prerequisite: Math. 480.

482. **Scattering Theory III. 4 hours.** Statistical scattering problems. Scattering by randomly moving distributions. Models for scattering by rough surfaces, gases, and liquids. Relations between scatterer statistics and signal statistics for low-speed distributions. Relativistic scattering problems. Prerequisite: Math. 481.

484. **Mathematical Techniques of Nuclear Reactor Theory I. 4 hours.** Same as Energy Engineering 484. Introduction to nuclear physics and nuclear reactor physics; flux distributions, critical mass, slowing down kernels and their Fourier transforms, two-group steady state theory in the reflected reactor, buckling iteration method, matrix methods in boundary value and criticality problems in the one-dimensional multiregion reactor, series solutions of group diffusion equations in multiregion reactor and in two-dimensional fully reflected reactor, reactor criticality codes. Prerequisites: Math. 312, 323, 341 or 348, and 381, or the equivalents.

485. **Mathematical Techniques of Nuclear Reactor Theory II. 4 hours.** Same as Energy

Engineering 485. Variational methods in the criticality problem, theory of control rods in cylindrical reactor, introduction to reactor kinetics, perturbation theory and applications, adjoint flux distributions, inhour equation for multiregion multifuel reactors, xenon poisoning and override problem. Prerequisite: Math. 484.

486. **Mathematical Techniques of Nuclear Reactor Theory III. 4 hours.** Same as Energy Engineering 486. Cylindrical reactor with source, power level determination problem, time-dependent flux distributions in multiregion reactor, one-group model, transient and stable flux distributions in multiregion reactor, two-group model, self-limiting power bursts, analysis of nonlinear feedback problems. Prerequisite: Math. 485.

489. **Advanced Topics in Applied Mathematics. 4 hours.** May be repeated for credit. Special topics in applied mathematics. Prerequisite: Consent of the instructor.

490. **Computer Programming for Students in Behavioral Sciences. 0 hours.** Seven-week introduction to Fortran IV. Examples from statistics, business, and the behavioral sciences. The Computer Center cooperates with departments imposing a language requirement in programming in setting examinations for this course.

491. **Computer Programming for Students in the Physical Sciences. 0 hours.** Seven-week introduction to Fortran IV. Examples from mathematics, engineering, and the natural sciences. The Computer Center cooperates with departments imposing a language requirement in programming in setting examinations for this course.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Prerequisite: Approval of the department.

Courses for Graduate and Advanced Undergraduate Students

300. **Teachers Course I. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. Important mathematical concepts and problems involved in teaching them; treatment of numeration system, set relations, functions, whole numbers, logic, and proof; examination of some of the major new curricula. Prerequisite: Math. 133.

301. **Teachers Course II. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. Continues Mathematics 300. Topics, discussed from an advanced viewpoint, include mathematical induction, the completeness axiom, composition of functions, sequences, a vector approach to geometry, axioms of the Hilbert type. Prerequisite: Math. 300.

302. **Teachers Course III. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. Continues Mathematics 301. Topics, discussed from an advanced viewpoint, include arithmetic and geometric progressions, continued sums and products, difference sequences, pigeon-hole principle, limits, continuity, exponential functions, logarithmic functions, circular functions, combinations and permutations. Prerequisite: Math. 301.

303. **Advanced Euclidean Geometry I. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. Geometry from Euclid to the present, equivalents of Euclid's fifth postulate, noneuclidean geometries, finite and projective geometries, invariants of configurations under transformation. Prerequisite: Math. 133.

304. **Advanced Euclidean Geometry II. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. The parallel postulate, similarity, area perpendicularity, circles and spheres, constructions with ruler and compass. Prerequisite: Math. 303.

305. **Advanced Euclidean Geometry III. 4 hours.** Graduate credit for this course may be applied only toward the course requirements for the degree of Master of Science in the Teaching of Mathematics. Ruler and compass constructions, proportionality, length and area, solid mensuration, hyperbolic geometry. Prerequisite: Math. 304.

307. **Theory of Sets and the Real Number System. 5 hours.** The elementary set theory and the development of the integers, the rational numbers, and the real numbers. Prerequisite: Math. 133.

310. **Higher Analysis I. 4 hours.** Real numbers, continuity, extensions of the mean value theorem, functions of several variables, partial derivatives. Prerequisite: Math. 133.

311. **Higher Analysis II. 4 hours.** Transformation, vectors, line and surface integrals. Prerequisite: Math. 310.

312. **Higher Analysis III. 4 hours.** Implicit functions, Riemann integration, infinite series, uniform convergence, power series, improper integrals. Prerequisite: Math. 311.

321. **Elementary Differential Equations II. 4 hours.** Systems of linear first order equations. Boundary value problems for second order linear equations, and introduction to partial differential equations. Nonlinear problems described by one or two differential equations of first order. Prerequisite: Math. 220.

322. **Elementary Partial Differential Equations I. 4 hours.** Second order linear partial differential equations and their initial value and boundary value problems. Separations of variables and Green's formula considerations. Eigenfunction expansions for homogeneous and inhomogeneous heat equation in finite domains. Sturm-Liouville problem. Fourier series. Prerequisites: Math. 310 and 321.

323. **Elementary Partial Differential Equations II. 4 hours.** The potential equation and the wave equation in finite domains. Semi-infinite domains. Fourier integrals. Cylindrical and spherical harmonics. Fourier-Bessel and Legendre-Bessel expansions. Prerequisite: Math. 322.

330. **Complex Analysis for Applications I. 4 hours.** Credit is not given for both Mathematics 330 and 332. Complex numbers and their geometrical representation, analytic functions, elementary functions, complex integration, Taylor and Laurent series, the calculus of residues, introduction to conformal mapping. Prerequisite: Math. 310.

331. **Complex Analysis for Applications II. 4 hours.** Branch-point integration, series and

product expansions, complex integral representations of special functions (gamma, hypergeometric, Legendre, Bessel), asymptotic methods, introduction to transforms. Prerequisites: Math. 321 and 330.

332. **Complex Variables I. 4 hours.** Credit is not given for Mathematics 332 and 330. Power series in one variable, holomorphic functions, Cauchy's integral, Taylor and Laurent expansions. Prerequisite: Math. 312.

333. **Complex Variables II. 4 hours.** Analytic functions of several complex variables, harmonic functions, convergence of sequences of holomorphic functions, infinite products, normal families, holomorphic transformations, holomorphic systems of differential equations. Prerequisite: Math. 332.

340. **Modern Higher Algebra I. 4 hours.** Sets and real numbers, groups, rings. Prerequisite: Math. 133.

341. **Modern Higher Algebra II. 4 hours.** Euclidean and polynomial rings, vector spaces, linear transformations, and matrices. Prerequisite: Math. 340.

342. **Modern Higher Algebra III. 4 hours.** Dual spaces, inner-product spaces, modules, canonical forms of matrices, quadratic forms. Prerequisite: Math. 341.

343. **Formal Logic I. 4 hours.** Same as Philosophy 343. Propositional logic, logic of quantifiers, and identity and completeness. Prerequisite: Consent of the instructor; none for mathematics majors.

344. **Formal Logic II. 4 hours.** Same as Philosophy 344. Continues Mathematics 343. Mathematical analysis of decidability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Individual conferences on assigned papers are required. Prerequisite: Math. 343.

348. **Linear Transformations and Matrices. 5 hours.** Matrix algebra, determinants, inverses of matrices, rank and equivalence, linear independence, vector spaces and linear transformation, unitary and orthogonal transformations, characteristic equation of a matrix. Prerequisite: Math. 133.

350. **Introduction to Higher Geometry I. 4 hours.** Projective properties in the euclidean plane, extending the euclidean plane, the projective plane, axioms for the projective plane, conics, introduction of coordinates. Prerequisite: Math. 342.

351. **Introduction to Higher Geometry II. 4 hours.** Topics in geometry, projective planes, higher dimensional projective geometries, model as subspaces of a vector space, coordinatization. Prerequisite: Math. 350.

352. **Introduction to Higher Geometry III. 4 hours.** Introduction to differential geometry, curves, surfaces, manifolds imbedded in euclidean space, Riemannian geometry, first and second fundamental forms of imbedded surfaces. Prerequisites: Math. 310 and 351.

355. **Introduction to Topology I. 4 hours.** Set theory, topological spaces, metric spaces, continuous maps, connectedness, compactness, separation axioms, completely separable spaces, mappings into Hilbert spaces. Prerequisite: Math. 310.

356. **Introduction to Topology II. 4 hours.** Locally connected spaces, arcs and arcwise connectivity, Cantor sets, Hahn-Mazurkiewicz theorem, elements of homotopy theory. Prerequisites: Math. 340 and 355.

357. **Introduction to Topology III. 4 hours.** Vector spaces, polytopes, homology theory, Euler-Poincare formula, simplicial mappings, Brouwer degree and Brouwer fixed-point theorem. Prerequisite: Math. 356.

360. **Elementary Theory of Numbers I. 4 hours.** The basic concepts of the theory of numbers: divisibility, prime numbers congruences, quadratic reciprocity law. Prerequisite: Math. 133 or approval of the department.

361. **Theory of Numbers II. 4 hours.** Functions of number theory, recurrence functions, diophantine equations, quadratic forms, Farey sequences and rational approximations. Prerequisite: Math. 360.

362. **Theory of Numbers III. 4 hours.** Continued fractions, distribution of primes, algebraic numbers, polynomials, partitions, density of sequences of integers. Prerequisite: Math. 361.

370. **Introduction to Probability and Statistics. 4 hours.** Probability models, univariate and multivariate distributions, random variables. Prerequisite: Math. 133.

371. **Statistics I. 4 hours.** Statistical problems and procedures, estimation, testing hypotheses, distribution theory. Prerequisite: Math. 370.

372. **Statistics II. 4 hours.** One-sample problems, comparison, linear models, and analysis of variance. Prerequisite: Math. 371.

375. **Probability. 4 hours.** Law of large numbers, central limit theorem, recurrent events, random walks, Markov chains. Prerequisite: Math. 370.

377. **Finite Differences I. 4 hours.** Difference formulas, finite integration, summation of series, Bernoulli and Euler polynomials, interpolation. Prerequisite: Math. 112 or 133.

378. **Finite Differences II. 4 hours.** Approximate integration, beta and gamma functions, difference equations. Prerequisite: Math. 377.

381. **Vector and Tensor Analysis I. 4 hours.** Algebra of vectors, vector differential calculus, differential goemetry, Stokes' theorem, divergence theorem, applications to electricity, mechanics, hydrodynamics, and elasticity. Prerequisite: Math. 311.

382. **Vector and Tensor Analysis II. 4 hours.** Transformation properties, covariant and contravariant tensors, differential geometry of curves and surfaces, exterior differential calculus with emphasis on aspects of interest in science and engineering. Prerequisite: Math. 381.

385. **Laplace Transforms. 3 hours.** The Laplace transform and its inverse; properties of the transform; linear differential equations (ordinary and partial); linear difference equations, gamma, error, and Bessel functions; asymptotic series; nonelementary integrals; integral equations, Hankel transforms. Prerequisite: Math. 330.

387.   **Numerical Analysis I. 4 hours.** Mathematics 387 and 388 together provide a comprehensive introduction to linear numerical analysis. Computational methods and error analysis for matrix inversion, eigenvalues and eigenvectors, and linear approximations. Prerequisites: Math. 133, and 194 or 195.

388.   **Numerical Analysis II. 4 hours.** Continues Mathematics 387. Prerequisite: Math. 387.

389.   **Numerical Analysis III. 4 hours.** Numerical integration and differentiation. Quadrature in n dimensions. Numerical integration of ordinary differential equations. Prerequisite: Math. 388.

391.   **Boolean Algebra and Switching Theory. 4 hours.** Sets, relations, functions, equivalence relations, abstract Boolean algebra. Applications of Boolean algebra. Minimization of Boolean functions. Representation of finite Boolean algebras. Prerequisite: Math. 310 or 340.

392.   **Introduction to Automata Theory. 4 hours.** Boolean rings and lattices as Boolean algebras. Synchronous sequential circuits. Mealy and Moore models of automata. Regular sets. Prerequisite: Math. 391.

393.   **Automata and Languages. 4 hours.** Types of automata and their events. The semigroup of an automaton. Basic decomposition theory. Introduction to formal languages. Grammars of types 0, 1, 2, 3. Properties of context-free languages. Prerequisite: Math. 392.

394.   **Simulation Languages. 4 hours.** Digital simulation of complex systems; general purpose and special simulation languages and their useful properties, their design and implementation; a comparison and evaluation of special languages such as GPSS II, SIMPSCRIPT, GASP, SIMPAC, DYNAMO, and SIMULATE: application of at least one of them in a term project. Prerequisites: Math. 280 and 281 or the equivalents.

395.   **List-Processing Languages. 4 hours.** List and string-processing languages, such as IPLV, SLIP, COMIT, SNOBOL, and LISP, from the user's point of view. Applications to nonnumeric problems such as symbolic formula manipulation, information retrieval, and pattern recognition. Prerequisites: Math. 280 and 281 or the equivalents.

396.   **Design of Compilers. 4 hours.** Design and implementation of algebraic compilers for a modern digital computer. Prerequisite: Math. 281.

399.   **Honors in Mathematics. 4 hours.** May be repeated for credit. Seminars on special topics and advanced problems to permit students majoring in mathematics to do independent study under the guidance of senior members of the staff. Prerequisites: Math. 312 and 342.

PHILOSOPHY

Professors
Donald A. Wells, Chairman of the Department; George T. Dickie, Arnold B. Levison, Ruth B. Marcus, Daniel J. Morris, William W. Tait, Irving Thalberg, Paul Ziff

Associate Professors
Terence D. Parsons, Brian Skyrms

Assistant Professors
Sandra L. Bartky, David C. Blumenfeld, Marcia Eaton, Kathryn P. Parsons, Rita N. Ziff (Visiting)

The department offers work leading to the degree of Master of Arts and Doctor of Philosophy.

Admission Requirements

Applicants must have a grade-point average of at least 4.00 for the last two years of undergraduate work. Students whose average is below 4.00 but above 3.75 will be considered on an individual basis. An undergraduate major in philosophy is not a requirement for admission.

Applicants should have taken courses in modern formal logic, ethics, history of philosophy, and theory of knowledge or philosophy of science. Students admitted with deficiences must take one or more of the following courses: Philosophy 301, 302, 304, 306, 321, 330, 332.

All students are required to take a qualifying examination during their first year of graduate study. This short written examination tests a student's ability to deal with philosophical problems.

Degree Requirements

Master of Arts

A student must choose at least one course in each of the following areas: history of philosophy; the theory of knowledge, including logic, philosophy of science, and the philosophy of language; and the theory of value, including ethics and aesthetics. The department also requires the student to complete a

unified program of 48 quarter hours of graduate study under the direction of an adviser and to pass the first-year qualifying examination at the Master's level.

Doctor of Philosophy

A full program consists of 16 hours of course work each quarter or a total of 144 quarter hours for the degree. The student must complete all requirements within seven years after entering the program. A student carrying a full program will generally be expected to complete the requirements in fewer than five years. Exceptions will be permitted only under conditions of unusual hardship.

Students progress toward the Ph.D. in three stages:

1. During the first year of study, they must take the first-year qualifying examination for advancement toward the doctoral program.
2. During the second year, they must take the comprehensive written examination. This examination consists of four parts: history of philosophy, logic and philosophy of science, metaphysics and epistemology, and value theory.
3. After a student has passed the comprehensive examination and has chosen the subject of his dissertation, an appointed doctoral committee will administer a preliminary oral examination to determine whether his research project is feasible and is sufficiently original and serious. The committee may then recommend formal advancement to candidacy for the Ph.D., and a member of the committee will be named to supervise the writing of the dissertation. Upon completion of his dissertation the candidate must defend it in a final oral examination.

The language requirement for each student will be decided by a departmental committee of graduate faculty. The determination will be based on a consideration of the area in which the student intends to specialize. In no case will proficiency in more than two languages be required. In those areas where the primary sources are in English, a foreign language may not be required.

A detailed statement of the special departmental requirements for graduate students can be obtained from the Department of Philosophy, 1803 University Hall.

Courses for Graduate Students

401.   Seminar: Topics in Ancient Philosophy. 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

403.   Seminar in Medieval Philosophy. 6 hours. May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Persistent problems in the philosophy of the Middle Ages.

405. **Seminar: Topics in Modern Philosophy. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive analysis of the work of one important philosopher or philosophical movement between 1600 and 1900.

407. **Seminar: Topics in Contemporary Philosophy. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive analysis of the work of one important philosopher or philosophical movement of the twentieth century.

411. **Seminar in Recent Ethical Theory. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

413. **Topics in Logic. 6 hours.** May be repeated once for credit with the consent of the instructor. Two sections may be taken concurrently when topics vary.

415. **Seminar in Metaphysics. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

417. **Seminar in the Philosophy of Science. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

419. **Seminar in the Philosophy of Language. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

421. **Seminar in the Theory of Knowledge. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Selected topics in the contemporary theory of knowledge.

423. **Seminar in Aesthetics. 6 hours.** May be repeated once for credit with the approval of the department. Two sections may be taken concurrently when topics vary. Intensive study of selected topics.

479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology. 2 hours.** Same as History 479 and Psychology 479. May be repeated. Systematic review of special topics, with emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

483. **Independent Study. 2 to 8 hours.** Topics and plan of study must be approved by the candidate's adviser and by the staff member who directs the work.

490. **Seminar in the Teaching of Philosophy. 1 hour.** May be repeated for credit. Discussion of problems connected with the teaching of introductory courses in philosophy. Required of all graduate students in philosophy unless excused by the department. All teaching assistants will be required to enroll during the tenure of their assistantships.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit.

Courses for Graduate and Advanced Undergraduate Students

301. **Plato. 4 hours.** Selected dialogues.

302. **Aristotle. 4 hours.** Reading and discussion of some of the basic works.

304. **Seventeenth Century Rationalism. 4 hours.** Selected readings and discussion from the works of Descartes, Spinoza, Leibniz.

306. **British Empiricism. 4 hours.** Selected readings from the works of such philosophers as Locke, Berkeley, and Hume.

308. **Kant. 4 hours.** Kant's philosophy, with emphasis on the *Critique of Pure Reason.*

310. **Nineteenth Century and Early Twentieth Century Thought. 4 hours.** May be repeated for credit with the approval of the department. Studies of selections from the writings of Hegel, Schelling, Fichte, Schopenhauer, Marx and Engels, J. S. Mill, Nietzsche, McTaggart, Green, Bradley, Peirce, Perry, and others. Prerequisite: Two courses in philosophy, one of which must be a 200-level course.

311. **Inductive Logic. 4 hours.** Traditional and contemporary problems of induction. Inductive logic and the theory of probability.

312. **Recent and Contemporary Philosophy: Analysis and Logical Empiricism. 4 hours.** Developments in recent philosophy which have their roots in the study of logic and language, such as logical atomism, positivism, and analytical philosophy.

314. **Recent and Contemporary Philosophy: Phenomenology and Existential Philosophy. 4 hours.** Important contributions to the phenomenological movement. Selected readings from Husserl, Heidegger, Jaspers, Sartre, Merleau-Ponty, and others. Prerequisite: Two courses in philosophy.

321. **Introduction to Formal Logic. 4 hours.** Four meetings per week coincide with Philosophy 211 (see Philosophy 211 description in Undergraduate Catalog). One additional meeting per week is devoted to an introduction to elementary set theory plus extra topics related to work in Philosophy 211.

322. **Problems in the Foundations of Logic and Mathematics. 4 hours.** Survey of selected problems. Prerequisite: Phil. 211 or the equivalent.

330. **Theory of Knowledge. 4 hours.** The grounds of belief; the nature of truth; evidence and proof; other related epistemological problems.

332. **Ethics and Value Theory. 4 hours.** The nature of moral judgments and moral reasoning; ethics as a normative discipline; definitions of "value"; ethical judgments as a kind of value judgment.

334. **Aesthetics. 4 hours.** The aesthetic object. Form, representation, and meaning in art. Art and knowledge. Prerequisite: Phil. 212 is recommended.

336. **Topics in Metaphysics. 4 hours.** Systematic analysis of selected metaphysical concepts, such as existence, substance and attribute, universals and particulars,

change, identity, space and time, and the individual. Recent as well as traditional points of view are considered.

338. **Philosophical Analysis of the Concept of Mind. 4 hours.** Presuppositions and logical interconnections involved in the use of such terms as "mind," "thoughts," "action," and "will."

340. **Philosophy of Language. 4 hours.** Philosophical and logical problems concerned with the nature of meaning and the structure of language. Individual conferences on assigned papers are required. Prerequisites: Two courses in philosophy, one of which must be any 200-level course except Phil. 211. In addition Phil. 211 or 343 or some demonstration of familiarity with the techniques of symbolic logic is required. In the last case, consent of the instructor is required.

343. **Formal Logic I. 4 hours.** Same as Mathematics 343. Propositional logic, logic of quantifiers, and identity and completeness. Individual conferences on assigned papers are required. Prerequisite: Consent of the instructor; none for mathematics majors.

344. **Formal Logic II. 4 hours.** Same as Mathematics 344. Continues Philosophy 343. Mathematical analysis of decidability and computability. Arithmetization of syntax. Incompleteness and undefinability theorems. Introduction to axiomatic set theory. Individual conferences on assigned papers are required. Prerequisite: Phil. 343.

345. **Philosophical Problems of the Sciences. 4 hours.** May be repeated for credit with the permission of the department. Reading and discussion of selected works on the aims and methods of science, the status of scientific theories, natural laws and theoretical entities, and the nature of explanation.

351. **Problems in the Philosophy of Mathematics. 4 hours.** Intensive study of a particular problem or nexus of problems in the philosophy of mathematics. Prerequisite: Phil. 343; none for mathematics majors.

399. **Independent Study. 1 to 8 hours.** Independent study, under the supervision of a staff member, of a topic not covered in the regular curriculum. The course is offered at the request of the student and only at the discretion of the staff members concerned. Prerequisite: Approval of the department.

PHYSICS

Professors
Swaminatha Sundaram, Head of the Department; Seymour Bernstein, Arnold R. Bodmer, James S. Kouvel, Edward B. McNeil, R. Curtis Retherford, Herman B. Weissman, Lester Winsberg

Associate Professors
Stanley Aks, Alan S. Edelstein, James W. Garland, Gloria A. Hoff, Seymour Margulies, William J. Otting, John N. Pappademos, David S. Schreiber, Ram R. Sharma, David J. Vezzetti

Assistant Professors

Larry L. Abels, Richard A. Carhart, Martin Garrell (Visiting), Howard S. Goldberg, Jack A. Kaeck, Stephan J. Krieger, Donald W. McLeod, James G. Ring (Visiting), Donald M. Rote, Julius Solomon

The department offers graduate work leading to the degrees of Master of Science and Doctor of Philosophy in physics with the following areas of specialization:

Atomic and molecular physics — oscillator strengths, vibrational and rotational spectra, high temperature properties.

High energy physics — particle decays and resonances using facilities at Argonne National Laboratory and, in the future, at Weston accelerator.

Nuclear physics — nuclear reactions, nuclear structure, using facilities at Argonne and Weston.

Solid state physics — magnetic resonance, thermal conductivity and electron tunneling at low temperatures of metals, alloys, and superconductors, optical and dielectric properties of solids.

Theoretical physics — strong interactions in elementary particles, nuclear structure, hypernuclei, quantum field theory, superconductivity, liquid helium, magnetic resonance relaxation processes, and other problems in metals and alloys, atomic and molecular structure.

Admission Requirements

In addition to meeting the requirements of the Graduate College, applicants must have 30 quarter hours (20 semester hours) of courses in physics beyond the level of general physics, including Physics 301, 302, 321, and 341, or their equivalents, and a grade-point average of at least 3.75 for the last 90 quarter hours of undergraduate work. Applicants with grade-point averages below 3.75 but above 3.50 may be admitted under special circumstances. Applicants who have majored in fields other than physics and who meet the other academic requirements may be considered for admission, but they will be required to take the necessary undergraduate courses without credit in order to prepare themselves for successful participation in graduate work.

Degree Requirements

Master of Science

The minimum requirements are 48 quarter hours of course work with at least 24 hours in physics, including mechanics, electrodynamics, and quantum

mechanics. Twenty quarter hours must be in 400-level courses with at least 16 hours in physics other than Physics 499, Thesis Research. A thesis is optional; if it is elected, a maximum of 12 quarter hours may be allowed for Physics 499.

Doctor of Philosophy

The minimum requirements for the Ph.D. in physics are: completion of the equivalent of two full years of approved course work beyond the Bachelor's degree; passing a written qualifying examination covering mechanics, electrodynamics, quantum mechanics, and elementary modern physics; passing a preliminary examination which may be written or oral or both after the completion of all course work; and passing a final oral examination on a thesis acceptable to the examining committee. There is no requirement of proficiency in a foreign language.

Courses for Graduate Students

401. **Electrodynamics I.** 4 hours. Maxwell's equations; static and time-dependent fields; boundary value problems; wave propagation. Prerequisite: Phys. 303 or approval of the department.

402. **Electrodynamics II.** 4 hours. Classical theory of radiation; radiation reaction; special relativity; covariant formulation of electrodynamics. Prerequisite: Phys. 401 or approval of the department.

403. **Electrodynamics III.** 4 hours. Lagrangian formulation of electrodynamics; action principles; special topics in electromagnetic theory. Prerequisite: Phys. 402 or approval of the department.

411. **Quantum Mechanics I.** 4 hours. Wave functions, uncertainty principle and Schrodinger equation, one and three-dimensional one-particle problems, approximate methods. Prerequisite: Phys. 322 or approval of the department.

412. **Quantum Mechanics II.** 4 hours. Operators and Hilbert space formulation, symmetries and conservation laws, angular momentum and rotations, coupling of angular momenta, spherical tensors, scattering, phase shifts, Born series, scattering in Coulomb field, inelastic scattering. Prerequisite: Phys. 411 or approval of the department.

413. **Quantum Mechanics III.** 4 hours. Introduction to formal theory of scattering, S-matrix, time-dependent and independent formulations of scattering, introduction to relativistic quantum mechanics, Klein-Gordon and Dirac equations, introduction to quantum field theory, electromagnetic transitions, particles and antiparticles. Prerequisite: Phys. 412 or approval of the department.

414. **Advanced Quantum Mechanics I.** 4 hours. Canonical quantum field theory, quantiza-

tion of the electromagnetic field, the Dirac field, the scalar and pseudoscalar meson fields, the interactions of quantum fields with classical fields. Prerequisite: Phys. 413 or approval of the department.

415. **Advanced Quantum Mechanics II. 4 hours.** Interacting quantum fields, the S-matrix, the Dyson expansion and diagrams, applications to problems in quantum electrodynamics, renormalization and its physical interpretation. Prerequisite: Phys. 414 or approval of the department.

421. **Atomic and Molecular Physics I. 4 hours.** Hydrogen atom and one-electron systems, helium atom, self-consistent field theory, alkali spectra, vector model, Zeeman and Stark effects, fine and hyperfine structure, collisions, ionization. Prerequisite: Phys. 322 or approval of the department.

422. **Atomic and Molecular Physics II. 4 hours.** Rotation and vibrational energies of diatomic molecules, potential curves, electronic transitions and transition moments, intensities, thermodynamic properties, applications. Prerequisite: Phys. 322 or approval of the department.

423. **Atomic and Molecular Physics III. 4 hours.** Structure and symmetry of molecules, vibrational and rotational spectra, experimental infrared and Raman spectra, chemical bonding, molecular interactions, molecular collisions, intermolecular potentials, relaxation phenomena. Prerequisite: Phys. 322 or approval of the department.

425. **Solid State Physics I. 4 hours.** Crystal structure, X-ray methods, crystal forces, lattice theory, vibrations, heat conductivity. Prerequisite: Phys. 323 or approval of the department.

426. **Solid State Physics II. 4 hours.** Electric and magnetic properties of solids, free-electron model of metals, quantum statistics, band theory, order-disorder theory. Prerequisite: Phys. 425 or approval of the department.

427. **Solid State Physics III. 4 hours.** Semiconductors, ferromagnetism and antiferromagnetism, superconductivity, lattice vacancies, color centers, excitons, luminescence. Prerequisite: Phys. 426 or approval of the department.

428. **Quantum Theory of Solids I. 4 hours.** Introduction to quantum mechanics of noninteracting particles in a periodic potential, band structure of solids, optical properties of solids, dynamics of electrons in a magnetic field and a crystal potential. Prerequisites: Phys. 412, 427, and 461, or approval of the department.

429. **Quantum Theory of Solids II. 4 hours.** The electron-phonon interaction, collective excitations in solids, phonons, plasmons, polarons, magnons, excitons, quasiparticles, Landau theory of the Fermi liquid, the Hartree-Foch, RPA, and SCF approximations, generalized susceptibility, introduction to Green's functions, and diagrammatic techniques in solids. Prerequisites: Phys. 414 and 428, or approval of the department.

430. **Quantum Theory of Solids III. 4 hours.** May be repeated for credit by arrangement with the department. Topics will vary from year to year. Special topics in the modern theory of solids, superconductivity, ferromagnetism, liquid helium, theory of alloys, theory of liquids, theory of defects in semiconductors, applications of group theory to solid state physics, etc. Prerequisite: Phys. 429 or approval of the department.

431. **Elementary Particle and Nuclear Physics I. 4 hours.** Two-nucleon system: properties of the deuteron, nucleon-nucleon scattering, nuclear forces. Properties of pions and pion-nucleon scattering, other nonstrange mesons; introduction to strange particles and higher symmetries. Prerequisite: Phys. 412 or approval of the department.

432. **Elementary Particle and Nuclear Physics II. 4 hours.** General properties of nuclei: sizes, binding energies, stability, saturation. Introduction to nuclear models and structure. Beta decay and weak interactions. Prerequisite: Phys. 431 or approval of the department.

433. **Nuclear Physics I. 4 hours.** Review of two-nucleon system and nuclear forces, nuclear models and nuclear spectroscopy. Individual-particle model, collective model, particle-hole excitations, pairing, electromagnetic interactions. Prerequisites: Phys. 413 and 432, or approval of the department.

434. **Nuclear Physics II. 4 hours.** Nuclear reactions: compound nucleus, optical model, direct reactions. Nuclear forces and nuclear structure; light nuclei, nuclear many-body problem; nucleon-nucleus scattering at high energies. Interactions of particles other than nucleons with nuclei. Prerequisite: Phys. 433 or approval of the department.

435. **Elementary Particle Physics I. 4 hours.** Fields and invariance principles, relativistic kinematics and scattering, strong and electromagnetic interactions of nonstrange particles. Pions and nucleons, resonances, introduction to dispersion relations, one-particle exchanges, electromagnetic form factors. Prerequisites: Phys. 413 and 432, or approval of the department.

436. **Elementary Particles II. 4 hours.** Strong interactions of strange particles; higher symmetries; weak interactions of nonstrange and of strange particles. Prerequisite: Phys. 435 or approval of the department.

441. **Classical Mechanics. 4 hours.** Variational principles; Lagrange and Hamilton equations; Hamilton-Jacobi theory; rigid body motion; small oscillations; continuous systems and fields. Prerequisite: Phys. 343 or approval of the department.

445. **Introduction to General Relativity. 4 hours.** Deficiencies of Newtonian gravitational theory, principle of equivalence, the metric field and geodesics, tensor analysis and differential geometry, Einstein's equations and the action principle, the energy-momentum pseudotensor, gravitational fields and waves. Prerequisites: Phys. 402 and 441 or approval of the department.

461. **Statistical Mechanics. 4 hours.** Classical and quantum-statistical mechanics; Maxwell, Bose, Fermi statistics; ensemble theory; imperfect gas; selected applications. Prerequisite: Phys. 361 or approval of the department.

481. **Mathematical Methods of Physics I. 4 hours.** Introduction to the linear methods of mathematical physics from the modern point of view. Mathematical foundations of quantum theory; classical problems of differential equations. Prerequisite: Approval of the department.

482. **Mathematical Methods of Physics II. 4 hours.** Applications of linear analysis to ordinary and partial differential equations and integral equations. Properties of

classical special functions and generalized functions. Prerequisite: Phys. 481 or approval of the department.

497. **Individual Study. 2 to 4 hours.** Special topics. Outside reading and term paper will be assigned by special arrangement with the department and faculty. Prerequisite: Approval of the department.

498. **Special Topics in Modern Physics. 4 hours.** Students may enroll in more than one section of this course concurrently. Seminar. Lectures on topics of current interest. Subjects are announced. Prerequisites: Phys. 411 and 412.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Prerequisite: Approval of the department.

Courses for Graduate and Advanced Undergraduate Students

301. **Electricity and Magnetism I. 4 hours, lecture and laboratory; 3 hours, lecture only.** Credit is not given to graduate physics majors and engineering majors. Applications of and problems in circuit theorems, electric fields, capacitance, energy and forces associated with these fields in free space and in matter. Prerequisites: Credit or registration in Phys. 114 and Math. 321.

302. **Electricity and Magnetism II. 4 hours, lecture and laboratory; 3 hours, lecture only.** Credit is not given to graduate physics majors and engineering majors. Applications of and problems in circuit theorems, magnetic fields, inductance, energy and forces associated with these fields in free space and matter, electromagnetic induction, Maxwell's equations. Prerequisite: Phys. 301.

303. **Electricity and Magnetism III. 4 hours, lecture and laboratory; 3 hours, lecture only.** Effects associated with changing fields and currents, transients, coupled circuits, filters, transmission lines, electromagnetic waves, circuit theorems in transient and steady-state analysis. Prerequisite: Phys. 302.

304. **Electronics I. 4 hours.** Theory of electronic devices, linear and nonlinear analysis, applications of vacuum and semiconductor devices to circuits, amplifiers, biasing, feedback, oscillators, and special circuits. Prerequisite: Phys. 301. Phys. 302 and 303 are recommended.

305. **Electronics II. 4 hours.** Pulse-shaping networks, logic circuits, control circuits, distributed amplifiers, special problems of transducers, special signal-to-noise techniques. Prerequisite: Phys. 304.

321. **Atomic Physics. 4 hours.** The properties of free electrons and ions, photons and their interaction with matter, atomic spectra and structure, introduction to quantum mechanics. Individual projects are required. Prerequisite: Phys. 114. Credit or registration in Math. 321 is recommended.

322. **Atomic and Molecular Physics. 4 hours.** Diatomic molecules: vibrational spectra, potential energy curves, chemical bonding, band structure. Polyatomic molecules;

Raman, infrared, rotational, and microwave spectra, force fields and chemical bonding. Individual projects are required. Prerequisite: Phys. 321.

323. **Elementary Solid State Physics. 4 hours.** Crystal structure, thermal and dielectric properties of solids, free electron model of metals, band theory, semiconductor physics, dislocations and strength of solids. Individual projects are required. Prerequisite: Phys. 322.

331. **Nuclear Physics. 4 hours.** Natural and artificial radioactivity, equipment for studying and producing high-energy particles, nuclear disintegrations, interaction of nuclear particles with each other and with matter, cosmic rays, mesons, recent developments in high-energy physics. Individual projects are required. Prerequisite: Phys. 321.

341. **Theoretical Mechanics I. 4 hours.** Credit is not given to graduate physics majors. Motion of a particle in one, two, and three dimensions, Kepler's laws and planetary motion, scattering of particles, conversion between laboratory and center of mass coordinate systems, conservation laws, motion of a rigid body in two dimensions. Individual projects are required. Prerequisites: Phys. 301 and Math. 321.

342. **Theoretical Mechanics II. 4 hours.** Statics of extended systems, moving coordinate frames, fictitious forces and conservation laws, special theory of relativity, mechanics of continuous media. Individual projects are required. Prerequisite: Phys. 341.

343. **Theoretical Mechanics III. 4 hours.** Rigid-body motion in three dimensions, motion in gravitational fields, generalized coordinates and Lagrange and Hamilton equations, equations of constraint, small-vibration theory. Individual projects are required. Prerequisite: Phys. 342.

361. **Thermal and Statistical Physics I. 4 hours.** Systems of particles, systems in equilibrium, laws of thermodynamics, thermal properties, application to simple physical and chemical systems, phase transitions, introduction to statistical mechanics. Individual projects are required. Prerequisite: Phys. 321.

362. **Thermal and Statistical Physics II. 4 hours.** Quantum statistics of ideal gases, magnetism and low temperatures, kinetic theory of transport processes, irreversible processes and fluctuations. Individual projects are required. Prerequisite: Phys. 361.

371. **Light (Wave Optics). 4 hours, lectures and laboratory; 2 hours, lectures only.** Wave propagation and Maxwell's equations, interference and interferometers, gratings, circular aperture, echelon, resolving power. Prerequisite: Phys. 114 and credit or registration in Math. 220.

372. **Light (Modern Optics) I. 4 hours, lecture and laboratory; 2 hours, lecture only.** Crystals, polarized light, optics of metals, quantum theory of radiation, transition probability and oscillator strength, dispersion and scattering theory. Lecture and laboratory. Prerequisite: Phys. 371.

373. **Light (Modern Optics) II. 4 hours.** Gaussian optics and general laws, special optical systems and applications. Image formation, finite image-error theory, spot diagrams. Necessary mathematical tools for Fourier analysis and transfer functions. Prerequisite: Phys. 372.

381. **Modern Experimental Physics I. 4 hours, lecture and laboratory; 1 hour, lecture only.**
Techniques and experiments in the physics of atoms, atomic nuclei, molecules, the solid state, and other areas of modern physical research. Prerequisites: Phys. 304 and 331.

382. **Modern Experimental Physics II. 4 hours.** Continues Physics 381. Lecture and laboratory. Prerequisite: Phys. 381.

POLITICAL SCIENCE

Professors
Richard M. Johnson, Head of the Department; Hollis W. Barber, Twiley W. Barker, Boyd R. Keenan, Milton Rakove

Associate Professors
Leonard E. Goodall, Doris A. Graber, Byung C. Koh, Frank Tachau

Assistant Professors
George D. Beam, Peter R. Knauss, Dick W. Simpson

The department offers courses leading to the degree of Master of Arts. Students may specialize in American government or public administration. A thesis is optional. The nonthesis option requires 48 hours of course work; the thesis option requires 40 hours of course work and 8 hours of thesis research.

Admission Requirements

Applicants must have a degree from an accredited institution of higher learning and a B average for the last two years of undergraduate work. Those with grade-point averages below 4.00 but above 3.75 will be considered in exceptional cases.

An applicant generally must present a Bachelor of Arts degree with a major in political science or with a minimum of 20 quarter hours in political science; or he may petition to be admitted by the department.

Applications for entrance with advanced graduate standing will be considered on the basis of individual preparation and merit.

All applicants are required to take the Graduate Record Examination. Information about this examination can be obtained from the head of the Department of Political Science. Performance on this examination, undergraduate academic record, and letters of recommendation from former teachers are the three principal kinds of evidence considered in making decisions about

admission and in the awarding of assistantships. It is particularly advantageous, therefore, for the prospective applicant to take this examination in the fall of his senior year.

Degree Requirements

The minimum requirements for the M. A. are:

Forty-eight quarter hours beyond the Bachelor's degree. Each student will select an area of concentration from the fields of American government or public administration. Usually, at least two courses will be taken outside the department.

Political Science 390, Scope and Methods of Political Science, or the equivalent.

A reading knowledge of French, German, Russian, or Spanish, or demonstrated competence in statistics or another acceptable research tool.

Three quarters of residence, not necessarily consecutive, with 24 quarter hours taken while in residence.

For those selecting the nonthesis option, a written examination covering the area of specialization and other work taken during the M. A. program.

For those selecting the thesis option, a thesis and an oral examination.

Courses for Graduate Students

408. **Government and Politics of Chicago. 4 hours.** The political process in Chicago, including an analysis of the city government and other governments such as the Park and Sanitary districts. The role of the political parties, business and civic leaders, the press, and other factors involved in the governmental process. Prerequisite: PolS. 205.

409. **Suburban Government and Politics. 4 hours.** Examination of government and politics in suburban America. Particular attention given to party structure, financing of governmental units, and the patterns of political competition in the suburbs. Prerequisite: PolS. 205.

412. **Problems in State Government. 4 hours.** Case analysis and research in selected problems dealing with the structure, functions, and administrative processes of American state governments. Prerequisite: PolS. 317 or 362.

415. **Urban Management Processes. 4 hours.** The political and administrative aspects of managing the urban environment. The course is designed to give the student a view of the specific tasks that face urban executives such as mayors, city managers, and department heads. Prerequisite: PolS. 212 or 317.

417. **Seminar in Legislation and Public Policy. 4 hours.** An intensive study of the institutional and dynamic forces that affect public policymaking in the United States. Emphasis on the separation of powers and the role of pressure groups, public

opinion, and organizational bureaucracies as they affect the decisionmaking process. Prerequisite: PolS. 315 or 316.

420. **Special Problems in Urban Government.** 4 hours. Intensive study of selected current problems. Maximum emphasis on providing the student with an opportunity to undertake and report on independent research. Prerequisite: PolS. 205.

451. **Problems in American Constitutional Law.** 4 hours. Research in selected problems evolving from conflicting interpretations of the United States Constitution. Prerequisite: PolS. 351 or 355 or the equivalents.

461. **Special Topics in Public Administration.** 4 hours. Analysis of selected problems. Topics considered vary from year to year, depending upon the needs and interests of the students. Prerequisite: PolS. 261.

462. **Seminar in Administrative Theory and Behavior.** 4 hours. Analysis of the theory of bureaucratic organization in several substantive areas. The nature and function of theory in administrative study; basic concepts, hypotheses, and research findings in organizational theory and behavior; leadership theory; decisionmaking; organizational authority; patterns of accommodation between the organization and its members. Prerequisite: PolS. 261. PolS. 329 is recommended.

463. **Seminar: Comparative and International Administration.** 4 hours. Supervised individual study of selected problems. Prerequisite: PolS. 363.

465. **Seminar in Politics and Administration.** 4 hours. The interplay between politics and administration. The manner in which politics shape and condition public administration and vice versa. Both theoretical materials and empirical case studies will be examined. Prerequisite: PolS. 261.

499. **Thesis Research.** 0 to 16 hours. May be repeated for credit. Open only to degree candidates. Individual study and research required of all students pursuing the advanced degree in political science under the thesis option.

Courses for Graduate and Advanced Undergraduate Students

306. **Ghetto Politics.** 4 hours. Analysis of the political impact of the ghetto on local, state, and national political systems; the impotency of the ghetto voter; the ghetto politician; ghetto riots as political protest; the ghetto and presidential politics. Individual conferences on assigned papers are required. Prerequisites: Three courses in political science or American history or sociology.

307. **Urban Politics Seminar.** 4 hours. Analysis of the structure and dynamics of political parties and organizations in urban areas. Intensive study of the power structure, strength, and weakness of the Democratic and Republican parties in urban areas, using Chicago and its suburbs as a laboratory. Prerequisites: PolS. 205 and consent of the instructor.

311. **Government and Politics of Metropolitan Areas.** 4 hours. The problems of governing metropolitan areas with special emphasis on evolving patterns of cooperation among

governments in metropolitan areas, such as metropolitan federalism, city-county consolidation, councils of governments, and regional planning commissions. Prerequisite: PolS. 205.

315. **Legislatures and Legislation. 4 hours.** The legislative function in government; structure and organization of American legislatures, national, state, and local; party organization in legislatures; legislative procedure; pressure groups and lobbying; relation of legislature to other branches of government; problems of legislative reorganization. Prerequisite: PolS. 151.

316. **The President and Congress. 4 hours.** Analysis of the relationship of the President and Congress and of the problems involved in the formulation and execution of public policy. Prerequisite: PolS. 151.

317. **Intergovernmental Relations. 4 hours.** The origin and evolution of the American federal system; federal-state constitutional relationships; intergovernmental fiscal relations; the political cultures; interstate relations; regionalism; state-local relations; interlocal relations and cooperative federalism in functional areas. Prerequisites: PolS. 151, and 205 or 212.

319. **The Public Administration of Science and Technology. 4 hours.** The response of public systems to the scientific and technological revolution and of the governmental institutions being devised to administer science and technology in the public sector. Emphasis on technological problems caused by the emergence of new metropolitan communities.

329. **Organizational Behavior. 4 hours.** The nature and forms of politically relevant organizational behavior in modern society; particular emphasis on the political environment of the organizations. Detailed analysis of one specific organization in its political-governmental setting. Prerequisites: PolS. 151 and 261.

337. **The Politics of Alienation. 4 hours.** Conceptual, empirical, and normative analysis of alienation from polity, society, culture, and self. Focus on political consequences of various forms of alienation, including radicalism, apathy, protest, revolution, renewal, and innovation. Empirical research is required. Prerequisite: PolS. 330.

353. **Seminar: Problems of Constitutional Law. 4 hours.** Opportunity for supervised individual study of selected problems arising in the interpretation of the United States Constitution. Prerequisites: PolS. 351 or 355 and consent of the instructor.

356. **Administrative Law. 4 hours.** Legal problems arising in the relationships between the citizen and the government official; administrative rulemaking and enforcement; judicial review of administrative actions. Prerequisite: Consent of the instructor.

362. **Seminar: Public Administration. 4 hours.** Supervised individual study of selected problems of public administration. Prerequisite: PolS. 261 or 363.

363. **Comparative and International Administration. 4 hours.** Analysis of bureaucratic structure and behavior in selected countries; examination of the problems and practices of the international civil servant. Consideration of a conceptual framework

for comparative administrative analysis. Prerequisite: PolS. 261 or 286 or one course in comparative government.

375.   The Political Development of the Middle East. 4 hours. Analysis of the contemporary politics of the countries of the Middle East, including the clash of traditional institutions and new social and political forces such as Islam, nationalism, the military, political parties, and ideological trends. Prerequisite: 6 hours of political science or modern history at the 200 level or higher. PolS. 380 is recommended.

376.   International Relations of the Middle East. 4 hours. Regional problems such as the drive for Arab unity, the Arab-Israeli dispute, the role of the region in world politics, and the decline of western influence in the area. Prerequisite: PolS. 284 or a course in modern diplomatic history at the 200 level or higher.

380.   Introduction to the Study of Emerging Nations. 4 hours. A comparative study of the political, economic, and social characteristics of underdeveloped nations. Discussion of colonialism, nationalism, political ideologies, and problems of effective political organization and functioning. Prerequisite: Two 200-level courses in political science, economics, sociology, or modern history.

381.   Politics of Emerging Areas. 4 hours. Analysis of selected governments and blocs of governments in Asia, Africa, and Latin America which represent different types of problems and different stages of the development process. Relations between underdeveloped and developed areas. Prerequisite: PolS. 380 or one course in non-Western politics.

387.   International Law. 4 hours. The theory and practice of international law; particular reference to its evolving role in the contemporary world. Decisions of international tribunals, past and present, are analyzed, and the contributions of the United Nations to the progressive development of international law are examined. Prerequisites: PolS. 151 and one course in international relations or organization.

388.   Seminar: Problems in American Foreign Relations. 4 hours. Supervised individual study of selected problems of contemporary United States foreign relations. Prerequisite: PolS. 281 or 284.

390.   Scope and Methods of Political Science. 4 hours. An examination of the scope and subject matter of political science. Special attention to analytic processes in the development of concepts, hypotheses, and theories. Methodologies and modes of analysis now in use by political scientists. Prerequisites: PolS. 151 and one 200-level course in political science.

391.   Political Power. 4 hours. Examines the problem of the nature of political power. The student is introduced to some of the major literature of power, and the development of the concept of political power as a descriptive category adequate to the comparative analysis of broader political phenomena, as parties, official decision-making structures, and movements. Prerequisites: PolS. 151 and 4 hours of 200 or 300-level political science courses.

394.   The History of Political Theory. 4 hours. Continues Political Science 393. Examination of the development of political theory from the seventeenth century to the

contemporary period. The influence of Hobbes, Locke, and Rousseau on the development of liberalism and the modern welfare state. Analysis of the crisis of modern democracy against the challenges of Marxism and totalitarianism. Examination of some contemporary theorists whose work parallels that of Hobbes, Locke, Rousseau, Burke, Marx, and J. S. Mill. Prerequisite: PolS. 393.

PSYCHOLOGY

Professors
Harry S. Upshaw, Acting Head of the Department; Philip Ash, Rosalind D. Cartwright, John D. Davis, Leonard D. Eron, Isadore E. Farber, Harold Klehr, Eli A. Lipman, Susan M. Markle, Sheldon Rosenberg

Associate Professors
Gershon Berkson, Alvin G. Burstein, Roger L. Dominowski, Allen H. Howard, Vivian C. Lipman, Nan E. McGehee, Evalyn F. Segal, Robert S. Wyer, Jr.

Assistant Professors
Philip E. Freedman, Charles L. Gruder, Leon Miller, Alexander J. Rosen, Herbert H. Stenson, Thomas Tyler

The department offers work leading to the degrees of Master of Arts and Doctor of Philosophy. Areas of specialization include experimental psychology and general psychology.

Admission Requirements

Departmental requirements are as follows:

A grade-point average of 4.00 for the last two years of undergraduate study. A student whose average is below 4.00 may be considered on the basis of individual merit.

The equivalent of 24 quarter hours in psychology, including statistics and a laboratory course in experimental psychology.

One year of college mathematics and one year of laboratory courses in physical and/or biological science.

Satisfactory scores on the aptitude (verbal and quantitative) tests of the Graduate Record Examination.

It may not be possible to accept all applicants who meet the foregoing minimal requirements. Preference will be given to candidates particularly well qualified in mathematics and the natural sciences. In special cases, candidates

who do not fulfill all course requirements may be admitted provisionally, pending satisfactory completion of these requirements without graduate credit.

Degree Requirements

Master of Arts

Candidates must complete 48 quarter hours of graduate-level course work (including research) and present an acceptable thesis. At least 16 quarter hours must be in 400-level courses.

All candidates must successfully complete four courses chosen from the following: 310, 345, 350, 352, 355, 356, 362, 370, 410, 420, and 447. In addition they must complete Psychology 343, 12 hours in their area of specialization, and 4 hours of thesis research. The remaining 16 hours may be taken in any area of psychology or in other departments.

Doctor of Philosophy

Candidates must complete 144 quarter hours of graduate-level course work (including research), pass preliminary examinations, demonstrate proficiency in special research skills, and present an acceptable dissertation. Courses offered in fulfillment of these requirements must include 343, 443, and either 444 or 445, all of which must be completed during the first two years of residence. In addition, all candidates must offer credit in graduate courses (to be specified at a later date) in learning and sensation-perception, as well as in four of the following areas: developmental psychology, psychological measurement, motivation, physiological psychology, psycholinguistics and verbal behavior, and social psychology. Among the special research skills in which proficiency is required are computer programming (for all candidates) and two of the following: a foreign language, laboratory instrumentation, or psychometric instrument construction.

Courses for Graduate Students.

Note: The prerequisites stated apply to graduate majors in psychology. Students minoring in psychology or majoring in related fields may, with the consent of the instructor, enroll in certain courses without having met all prerequisites.

410. **Experimental Approaches to Personality. 4 hours.** Analysis of empirical and theoretical advances in experimental research in personality. Emphasis on the interaction of

experimental factors in learning, motivation, and cognition with individual differences variables. Prerequisite: Consent of the instructor.

411. **Small Groups: Structure and Process. 4 hours.** Same as Sociology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.

416. **Theories of Social Behavior. 4 hours.** Current theoretical formulations and relevant data concerning major aspects of social behavior. Prerequisite: Psch. 310 or the equivalent.

420. **Advanced Developmental Psychology. 4 hours.** Theory and research on psychological development through adolescence; physical, mental, and social growth. Prerequisites: Psch. 220 or the equivalent and consent of the instructor.

425. **Practicum in Developmental Psychology. 2 hours.** May be repeated. Supervised practice in the observation and assessment of behavior development in naturalistic settings, including preschool, grade school, and special treatment units. Normal and exceptional children and adolescents. Prerequisites: Psch. 420 or the equivalent and consent of the instructor.

429. **Seminar in Developmental Psychology. 2 hours.** May be repeated. Systematic review of special topics, with emphasis on current research. Prerequisites: Psch. 420 or the equivalent and consent of the instructor.

430. **Psychological Counseling. 4 hours.** Basic principles, practices, and theories of counseling. Prerequisite: Consent of the instructor.

434. **Practicum in Business and Industrial Psychology. 2 to 4 hours.** May be repeated. Supervised practicum in a business or industrial setting. Personnel selection, evaluation, training, organization, morale, human factors, advertising, and consumer psychology. Prerequisite: Psch. 332.

435. **Practicum in Psychological Counseling. 2 hours.** May be repeated. Supervised practice in a counseling or clinical setting. Application of basic principles; special emphasis on the problems of the culturally disadvantaged. Prerequisites: Psch. 430 and consent of the instructor.

436. **Personnel Measurement Techniques in Industry. 4 hours.** Development, analysis, and use of tests in the selection, classification, and performance evaluation of industrial personnel. Practice in the development and validation of industrial classification and selection of test batteries will be included. Prerequisites: Psch. 332 or the equivalent and Psch. 345.

438. **Seminar in Business and Industrial Psychology. 2 hours.** May be repeated. Systematic review of special topics, with emphasis on current research and theoretical developments. Prerequisite: Consent of the instructor.

439. **Seminar in Psychological Counseling. 2 hours.** May be repeated. Systematic review of special topics, with emphasis on current research. Prerequisite: Psch. 430 and consent of the instructor.

441. **Survey Research Methods.** 4 hours. Same as Sociology 404. Methods of sampling human populations; interviewing techniques; techniques of analyzing survey data; the uses and limits of sample surveys in testing hypotheses; supervised participation in survey research. Prerequisite: Psch. 343 or the equivalent.

443. **Advanced Statistics II.** 4 hours. The Chi-square and F-distributions, analysis of variance, individual comparisons, regression, and correlation analysis. Prerequisite: Psch. 343 or the equivalent.

444. **Design of Experiments.** 4 hours. Advanced experimental designs in behavioral research. Testing of hypotheses concerning contrasts in means in single-factor and multifactor, completely randomized, and repeated measurement designs. Prerequisite: Psch. 443 or the equivalent.

445. **Correlational Methods.** 4 hours. Multiple, partial, curvilinear, biserial, and tetrachoric correlation; discriminant analysis; correlation ratio; sampling theory applied to correlation. Prerequisite: Psch. 443 or the equivalent.

447. **Psychological Measurement.** 4 hours. Scaling theory and methodology, with emphasis on measurement in psychophysics, differential psychology, and social psychology. Prerequisites: Psch. 343, and 315 or 356, or the equivalents.

449. **Seminar in Quantitative Methods in Psychology.** 2 hours. May be repeated. Systematic review of special topics, with emphasis on current developments and applications. Prerequisite: Consent of the instructor.

451. **Behavior Modification.** 4 hours. Critical analysis of principles, techniques, and research in the modification of behavior of normal and deviant individuals. Applications to problems of development, mental retardation, delinquency, behavior disorder, vocational training, and social interaction. Prerequisite: Psch. 350 or the equivalent.

459. **Seminar in Experimental Psychology.** 2 hours. May be repeated. Systematic review of special topics, with emphasis on current research and theoretical development. Prerequisite: Consent of the instructor.

470. **Theories of Learning.** 4 hours. Historical and methodological analysis of theoretical formulations of learning. Prerequisite: Psch. 350.

472. **Theories of Personality.** 4 hours. Same as Sociology 418. Contemporary theoretical formulations concerning personality and their evidential basis. Prerequisite: Psch. 350 or 352.

479. **Seminar: Theoretical, Historical, and Philosophical Issues in Psychology.** 2 hours. Same as History 479 and Philosophy 479. May be repeated. Systematic review of special topics, with emphasis on current approaches and interpretations. Prerequisite: Consent of the instructor.

480. **Behavior Disorders in Children.** 4 hours. Major types of maladjustment in childhood. Emphasis on the emotional, motivational, and intellectual difficulties of the culturally deprived. Prerequisite: Consent of the instructor.

482. **Psychological Appraisal: Intellectual Functions. 4 hours.** Theory, research, and techniques relating to psychological assessment of intellectual abilities and disabilities. Training in the administration, scoring and interpretation of standard test methods. Prerequisites: Psch. 243 or the equivalent and consent of the instructor.

484. **Psychological Appraisal: Personality. 4 hours.** Theory, research, and techniques relating to psychological assessment of personality. Training in the administration, scoring, and interpretation of structured tests and projective techniques. Prerequisites: Psch. 482 and consent of the instructor.

485. **Practicum in Psychological Appraisal. 2 hours.** May be repeated. Supervised practice in psychodiagnostic testing in various facilities associated with the graduate training program in clinical and counseling psychology. Prerequisites: Concurrent registration in Psch. 482 or 484 and consent of the instructor.

486. **Social and Cultural Factors in Health and Disease. 4 hours.** Same as Sociology 452. Methods of social epidemiology as applied to chronic and acute disease; psychosocial factors in illness; individual and social reactions to health and disease. Prerequisites: Psch. 380 or Soc. 351 or the equivalent.

489. **Seminar in Psychological Appraisal. 2 hours.** May be repeated. Systematic review of special topics, with emphasis on current research, methods, and theories. Prerequisite: Consent of the instructor.

490. **Colloquium in the Teaching of Psychology. No credit.** Registration open to departmental assistants only. Problems and methods of teaching at the college level. Group discussion techniques; task analysis; test construction and analysis; curricular materials.

495. **Individual Research. 2 to 8 hours.** May be repeated. Research on special problems not included in graduate thesis. Prerequisite: Consent of the instructor.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Research on topic of graduate thesis. Prerequisites: Consent of the instructor; approval of research prospectus by thesis committee.

Courses for Graduate and Advanced Undergraduate Students

310. **Advanced Social Psychology. 4 hours.** Same as Sociology 315. A critical analysis of empirical research on social perception, communication and influence, group structure, role analysis, and socialization processes. Prerequisites: Soc. 185 or Psch. 243, and 16 hours in sociology or psychology.

315. **Psychology of Social Influence. 4 hours.** Methodology, results, and interpretations of studies of the influence of social variables on attitude development and modification, acculturation, perception, and judgment.

316. **Animal Behavior. 4 hours.** Principles and methods in the study of animal behavior; review of the social behavior of representative species in various phyla. Prerequisites: Psch. 241, BioS. 101, and 102.

317. **Social Development. 4 hours.** Theories and research on the effects of social evaluation, imitation, and observational learning, and other social factors on the development of cognition, language, and attitudes in children and adolescents. Emphasis on the consequences of impoverished or atypical social environments. Prerequisite: Psch. 220 or the equivalent.

318. **Experimental Social Psychology. 4 hours.** Critical survey of experimental studies of independence, power, influence, social learning and perception, and other aspects of social behavior, with laboratory practicum and demonstrations. Prerequisites: Psch. 115, 241, and 243 or the equivalents.

323. **Psychology of the Exceptional Child. 4 hours.** Methods, results, and interpretation of studies of physically, intellectually, and emotionally deviant children, with special reference to their implications for education and behavior modification. Prerequisite: 12 hours of psychology including Psch. 220 or the equivalent.

330. **Organizational Psychology. 4 hours.** Individual psychological group processes and their interaction with organizational structure. Behavioral factors in effective organizational change. Prerequisites: Psch. 130 and a course in social psychology, or the equivalents.

332. **Personnel Psychology. 4 hours.** Systematic study of the development and utilization of psychological techniques of personnel selection, classification, and assessment. Prerequisite: 12 hours of psychology including Psch. 230, 240, or 243, or the equivalents.

333. **Motivation and Morale in Industry. 4 hours.** Concepts and methods in the assessment and modification of employee motivation, attitudes, and morale. Prerequisite: 12 hours of psychology including Psch. 332, or the equivalent.

335. **Psychology of Industrial Training. 4 hours.** Psychological measurement techniques in assessing training needs and evaluating training effectiveness. Application of psychological techniques to the development of industrial training programs. Prerequisite: Psch. 332 or the equivalent.

338. **Psychology of Industrial Conflict. 4 hours.** Behavioral analysis of the causes, dimensions, and modes of resolution of industrial conflict with special emphasis on labor-management relations. Prerequisite: Psch. 330 or the equivalent.

343. **Advanced Statistics I. 4 hours.** Elementary probability theory, empirical and theoretical distributions, points and interval estimation, hypotheses testing. Prerequisite: 12 hours of psychology including Psch. 243 or the equivalent.

345. **Psychometric Applications. 4 hours.** Theory of psychological tests and measurement applied to problems of ability and personality testing; opinion sampling; reliability and validity; prediction and selection processes. Prerequisite: 12 hours of psychology including Psch. 243 or the equivalent.

350. **Learning and Conditioning. 4 hours.** Methods, results, and interpretation of experimental studies of basic learning processes in animal and human subjects. Prerequisites: 12 hours of psychology including Psch. 250 and 251 or the equivalents and consent of the instructor.

351. **Programmed Learning. 4 hours.** Theory and research in the techniques, applications, and results of programmed instruction. Prerequisite: 12 hours of psychology including Psch. 224 or the equivalent.

352. **Motivation. 4 hours.** Methods, results, and interpretation of experimental studies of basic motivational processes in animal and human subjects. Prerequisites: Psch. 250 and 251 or the equivalents and consent of the instructor.

354. **Verbal Behavior and Higher Processes. 4 hours.** Methods, results, and interpretations of experimental studies of verbal learning, retention, and transfer. Prerequisite: Psch. 252.

355. **Higher Processes. 4 hours.** Methods, results, and interpretations of experimental studies of language behavior, problem solving, concept formation, and creativity. Prerequisites: 12 hours of psychology and consent of the instructor.

356. **Sensory Processes and Perception. 4 hours.** Methods, results, and interpretation of experimental studies of sensory and perceptual processes. Emphasis on vision and audition. Prerequisites: Psch. 250 and 251 or the equivalents.

360. **Human Factors. 4 hours.** Application of experimentally derived principles of behavior to the design of equipment for efficient use and operation. Sensory and perceptual processes, motor skills, and experimental methodology. Prerequisite: 12 hours of psychology including Psch. 250 and 251 or the equivalents.

361. **Instrumentation in Psychology. 4 hours.** Use of transducers, programming equipment, and recording systems in psychological research. Prerequisite: Consent of the instructor.

362. **Physiological Psychology. 4 hours.** Methods, results, and interpretation of experimental studies of physiological and neurochemical correlates of learning, motivation, and perception. Laboratory demonstrations and problems. Prerequisite: Consent of the instructor.

370. **Systems and Theories. 4 hours.** Critical introductory analysis of major historical systems and their representation in current theoretical issues. Prerequisites: Psch. 250 and 251 or the equivalents and consent of the instructor.

380. **Abnormal Psychology. 4 hours.** Forms and determinants of behavior and personality disorders. Prerequisites: 12 hours of psychology and consent of the instructor.

382. **Introduction to Psychological Assessment. 4 hours.** Systematic analysis of the nature of psychological tests and their application; introduction to intelligence, achievement, personality, and interest tests. Practice in administration and interpretation. Prerequisites: 12 hours of psychology including Psch. 243 or the equivalent and consent of the instructor.

399. **Problems in Psychology. 2 to 12 hours.** May be repeated. Investigation of special problems under direction of a staff member. Prerequisites: Consent of the instructor and of the head of the department.

THE JANE ADDAMS GRADUATE SCHOOL OF SOCIAL WORK

Mark P. Hale, Director
George W. Magner, Acting Assistant Director

Professors
Jennette R. Gruener, Mark P. Hale, Florence L. Poole, W. Paul Simon, Mary Sullivan, L. Jane Wille

Associate Professors
Adelaide Dinwoodie, Margaret G. Holden, George W. Magner, Aleanor R. Merrifield, Barbara Moore, Narayan Viswanathan

Assistant Professors
Claire Anderson, Eloise J. Cornelius, Frieda Engel, Seymour Mirelowitz, Naomi L. Tillman, Harvey Treger

The Jane Addams Graduate School of Social Work offers, on both the Chicago Circle and the Urbana campuses, a program of professional study leading to the degree of Master of Social Work. Identical programs of academic studies and fieldwork are offered on the two campuses; groupwork training is available only at Chicago Circle. An undergraduate minor in social work is offered at Urbana; undergraduate courses are not offered at Chicago Circle.

The educational program of the Jane Addams School is designed to give the student the knowledge, skills, attitudes, and philosophy basic to all professional social work practice rather than merely to prepare him for positions in specific agencies. The curriculum is organized in four general areas: human growth and behavior, social work practice, social services, and research. The student spends an equal amount of his time in the classroom and in fieldwork.

In Chicago, fieldwork is concurrent with classwork. Students are ordinarily placed in two distinctly different types of agencies. However, the second-year placement is usually made on the basis of the student's career interest and on the method (social casework or social groupwork) in which he chooses to attain competence. Deference is, of course, given to any agency from which he may hold a scholarship. A demonstration project in social groupwork currently allows a second-year student to select either a group treatment or community-oriented placement.

Admission Requirements

A satisfactory undergraduate scholastic record, 20 hours in the social sciences, and evidence of personal suitability for the field are the basic

requirements. Applicants whose undergraduate grade-point average for the final two years is less than 3.50 on a 5.00 scale are not considered. The admissions committee also assesses promise for professional success in social work by evaluating emotional maturity as commensurate with age and experience, interest in and liking for people, ability to establish harmonious and helpful relationships, personal integrity as demonstrated by intellectual honesty and a sense of responsibility, and serious concern for improvement of the institutions of society.

Since the number of possible enrollments is limited and new students will be admitted only in the fall quarter, early application is advisable. Scholarships and fellowships are available through the School and through many public and private social agencies.

A bulletin about the School and application forms may be obtained by writing the Jane Addams School of Social Work at Chicago Circle, P. O. Box 4348, Chicago, Illinois 60680. A listing of casework agencies and field instructors is included in the School bulletin.

The Joint Program with McCormick Theological Seminary

A special curriculum has been arranged in cooperation with the McCormick Theological Seminary in Chicago through which students may simultaneously complete requirements for the degrees of Master of Social Work (casework or groupwork) and Bachelor of Divinity or Master of Arts in Christian Education or Master of Arts in Church and Community.

This program is for a limited number of students who plan to engage specifically in social services under religious auspices. It usually requires three years of graduate study at the Seminary and the School of Social Work. Financial assistance is available. Applicants must be accepted by both institutions and must apply to both. Seminary applicants should address: Department of Church and Community, McCormick Theological Seminary, 2330 North Halsted Street, Chicago, Illinois 60614.

Degree Requirements (Master of Social Work)

Hours: Candidates must successfully complete 96 quarter hours of graduate work (including work in each of the four general areas) with a cumulative grade-point average of 3.75. An average of 3.75 is required if a candidate is to remain in good standing. Those whose average falls below 3.75 in any quarter will be placed on probation and will be required to achieve a 3.75 minimum cumulative average by the end of the year.

Residence: A minimum of 36 quarter hours of resident credit is required; the candidate must carry a full program (12 quarter hours) at Chicago Circle for at

least three consecutive quarters. A maximum of 48 hours of credit may be transferred for work taken elsewhere.

Time Limit: All requirements must be completed within six years. Military service is deducted. Exceptions may be made only in unusual circumstances. Several plans have been developed for spreading the degree program over a three-year period with one year devoted to full-time work in residence.

A Typical Program in the Jane Addams Graduate School of Social Work
Chicago Circle Campus

First Year	Quarter Hours	Second Year	Quarter Hours
First Quarter		*First Quarter*	
SocW. 401 or 411	3	SocW. 404 or 414	3
SocW. 493	3	SocW. 444	3
SocW. 441	4	SocW. 474	2
SocW. 471	3	SocW. 496	2
SocW. 431	4	SocW. 434	6
	17		16
Second Quarter		*Second Quarter*	
SocW. 402 or 412	3	SocW. 405 or 415	3
SocW. 494	3	SocW. 445	3
SocW. 442	4	SocW. 475	2
SocW. 472	3	SocW. 497	2
SocW. 432	4	SocW. 435	6
	17		16
Third Quarter		*Third Quarter*	
SocW. 403 or 413	3	SocW. 406 or 416	3
SocW. 425	2	SocW. 476	2
SocW. 443	4	SocW. 498	2
SocW. 473	3	Elective	3
SocW. 433	4	SocW. 436	6
	16		16

Courses for Graduate Students

401. **Social Casework I. 2 to 4 hours.** Analysis and study of the underlying philosophy, concepts, generic principles, and methods of social casework; role of the case worker in offering service through a professional relationship.

402. **Social Casework II. 2 to 4 hours**. Continues development of social casework concepts and principles through analysis of case material from secondary settings. Consideration of psychological and cultural factors which affect the treatment process. Analysis of the interconnectedness of relationship, study-diagnosis, and treatment phases of social casework. Prerequisite: SocW. 401.

403. **Social Casework III. 2 to 4 hours**. Continues Social Work 402. Emphasis on increased independent analysis of case material and use of relevant source material related to specific cases. Learning experiences are arranged to assist the student to acquire greater integration of philosophy, concepts, and principles in social casework. Prerequisite: SocW. 402.

404. **Social Casework IV. 2 to 4 hours**. Continues study of casework principles and methods. Emphasis on work with clients with complex emotional and personality problems, the stresses which impair social and ego functioning, and the effects of agency setting. Prerequisite: SocW. 403.

405. **Social Casework V. 2 to 4 hours**. Casework methods adapted to treatment of children and their parents in child-serving agencies, including schools, child-placing agencies, and child-guidance clinics and hospitals. Collaborative work with other disciplines and the role of the social worker as a consultant and consultee are examined. Prerequisite: SocW. 404.

406. **Social Casework VI. 2 to 4 hours**. Casework theory and practice focused on multiple-client interviewing and family diagnosis and treatment. Current issues in casework theory and the changing role of the caseworker in a changing society are discussed. Prerequisite: SocW. 405.

411. **Social Group Work I. 2 to 4 hours**. Group-work methods, with focus on the worker's problems and procedures in understanding the group, its objectives, and its relationship to the agency. Beginning formulation of the worker's role in reference to assessment, interaction, analysis and small-group theory.

412. **Social Group Work II. 2 to 4 hours**. Further emphasis on group methods, with intensive application of understanding and working with individuals in the group and in the agency. Social work practice with groups, including relationship, use of program, and the helping processes. Prerequisite: SocW. 411.

413. **Social Group Work III. 2 to 4 hours**. The integration of concepts in the worker's role with the individual and the group; the referral processes. The worker's role as a strategy of intervention is developed. Prerequisite: SocW. 412.

414. **Social Group Work IV. 2 to 4 hours**. Advanced principles of social group work in direct service with the group, advanced group theory, and concepts of group stress and crisis situations. The development of criteria for analysis of the worker's role. Prerequisite: SocW. 413.

415. **Social Group Work V. 2 to 4 hours**. Further development of the concepts of the worker's role in direct service, with refinements illustrated from analysis of treatment groups in special settings. Work with individuals, family groups, and interdisciplinary elements in collaboration. Prerequisite: SocW. 414.

416. **Social Group Work VI. 2 to 4 hours.** The final course in the group-work sequence. Assists the student in the integration of method and analysis of his own practice. Emphasis is on the wider role or organizing and supervising group services. Selected concepts of subexecutive and supervisory functions are identified. Current issues and new modalities in social work with groups are developed. Prerequisite: SocW. 415.

425. **Community Organization. 2 to 4 hours.** Principles, concepts, and methods of community organization in social work at the neighborhood, local, state, national, and international levels.

431. **Field Instruction I. 3 to 6 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 401 or 411, which must precede or be taken concurrently.

432. **Field Instruction II. 2 to 6 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 402 or 412, which must precede or be taken concurrently.

433. **Field Instruction III. 3 to 6 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 403 or 413 which must precede or be taken concurrently.

434. **Field Instruction IV. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 404 or 414 which must precede or be taken concurrently.

435. **Field Instruction V. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 405 or 415 which must precede or be taken concurrently.

436. **Field Instruction VI. 4 to 8 hours.** The student is assigned to a social agency where, under the supervision of a field instructor, he carries selected cases or groups for direct service to the agency clientele. Prerequisite: SocW. 406 or 416 which must precede or be taken concurrently.

441. **Human Growth and Behavior I. 3 to 6 hours.** The major forces influencing the growth and behavior of the individual from birth through adolescence. Sociocultural, familial, physical, emotional, and intellectual factors as they enhance or retard social functioning. The relevance of this content to the profession of social work is constantly considered.

442. **Human Growth and Behavior II. 3 to 6 hours.** The individual's growth and behavior from early through late adulthood. Considerations of the essential developmental tasks and central conflicts for each major life phase, with attention focused on differentiating kinds of knowledge about personality and social functioning. Prerequisite: SocW. 441.

443.   **Human Growth and Behavior III. 3 to 6 hours.** The nature and dynamics of social processes as related to growth and behavior. Study is centered on various groups within society — the family, class, ethnic group, and caste — and on the manner in which they influence individual personality development. The process of interaction and the meaning of membership within small groups is studied. Consideration is given to role expectations and the dynamics of small-group membership, particularly in the family. Attention is focused on the continuous process of change in group life and its effect on behavior. Prerequisite: SocW. 442.

444.   **Human Growth and Behavior IV. 3 to 6 hours.** Interrelationship of physical, emotional, and social aspects of selected diseases; implications for the patient, family, and community. Concept of "disease" as reflecting loss of equilibrium. Role of social work in collaboration with other disciplines concerned with provision of medical and rehabilitation services. Prerequisite: SocW. 443.

445.   **Human Growth and Behavior V. 3 to 6 hours.** Psychopathology, including neuroses, psychoses, character disorders, psychosomatic dysfunction, organic conditions, and mental retardation. Discussion of diagnosis and treatment methods, including psychotherapy, somatic and drug therapies, and social work. Prerequisite: SocW. 444.

461.   **Special Studies in Social Work I. 2 to 6 hours.** Independent or group study in areas of special interest; application of social work principles to special problems or settings.

471.   **Social Services and Welfare Policy I. 2 to 4 hours.** The function, nature, and scope of the social welfare institution. Social services as a response to social, personal, and economic problems of people. Effects of economic and social growth and change on the welfare enterprise.

472.   **Social Services and Welfare Policy II. 2 to 4 hours.** Social Work 472 and 473 will cover current provisions and alternatives for their solution in the social security and money assistance programs. Prerequisite: SocW. 471.

473.   **Social Services and Welfare Policy III. 2 to 4 hours.** Continues Social Work 472. Prerequisite: SocW. 472.

474.   **Social Services and Welfare Policy IV. 2 to 4 hours.** Current provisions and critical evaluation of welfare policy issues; alternatives for their solution in the social services for the aged, children, court wards, and the mentally and physically ill. Prerequisite: SocW. 473.

475.   **Social Services and Welfare Policy V. 2 to 4 hours.** Continues Social Work 474. Prerequisite: SocW. 474.

476.   **Administration in Social Work. 2 to 4 hours.** Principles, concepts, and processes in social work administration. Special emphasis on leadership, policy and decision-making, planning, and program organization.

493.   **Social Research I. 2 to 4 hours.** Objectives of social research, design of experiments, and measurement and methods of collecting data.

494.   **Social Research II. 2 to 4 hours.** Continues Social Work 493. Design of questionnaires and schedules; methods of data analysis, including statistical hypothesis testing and

applications of inferential techniques; interpretation of results; preparation of the report; review of selected studies. Prerequisite: SocW. 493.

495. **Social Research III. 2 to 4 hours.** Seminar and tutorial as an aid to developing the research problem to be followed in the second year. Prerequisite: SocW. 494.

496. **Research Project I. 2 to 4 hours.** Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 495.

497. **Research Project II. 2 to 4 hours.** Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 496.

498. **Research Project III. 2 to 4 hours.** Application of research methods to a social work problem in an individual or a group project. Prerequisite: SocW. 497.

SOCIOLOGY

Professors
Robert L. Hall, Head of the Department; Robert E. Corley, Peter P. Klassen, Roger W. Little, Mildred A. Schwartz, Ethel Shanas

Associate Professors
M. Rue Bucher, James T. Carey, William W. Erbe, John W. C. Johnstone, George J. McCall

Assistant Professors
Butler P. Crittenden III, Ozzie L. Edwards, John W. Martin, Gerald M. Swatez, Ronald C. VanderKooi, Mary G. Wiley

The department offers work leading to the degree of Master of Arts in general sociology. The program aims to provide basic familiarity with the concepts, the techniques, and the substance of three broad subfields — social organization, social psychology, and demography and human ecology. The student's thesis research may be in a specialized area such as medical sociology, urban sociology, or political sociology.

Admission Requirements

Grade-Point Average: 4.00 (A=5.00) for the last two years of undergraduate work. Students whose average is between 3.75 and 4.00 may petition for consideration.

Graduate Record Examination: Satisfactory scores on the aptitude tests (verbal and quantitative). The advanced test in sociology is required as an aid in advising students but will not be a factor in admission.

Hours: Students without strong undergraduate preparation in sociology are encouraged to apply if they meet the above standards. They will be required to complete extra courses to remedy deficiencies.

Students who have completed some graduate study elsewhere must, in addition to the above requirements, offer a grade-point average of 4.50 in previous graduate study. Training in logic, philosophy of science, mathematics, and statistics is strongly recommended for students expecting to study for a graduate degree in sociology. Preference is given in admission to students who have completed such training.

Degree Requirements

Forty-eight quarter hours, including Sociology 400, 401, and 402, Theory and Method in Sociology; and 8 quarter hours in Sociology 499, Thesis Research; satisfactory completion of a thesis; satisfactory completion of a comprehensive examination.

Courses for Graduate Students

400. **Theory and Method in Sociology. 4 hours.** Detailed examination of middle-range theories such as compliant behavior, status congruence, and intervening opportunities in migration; the means of bringing evidence to bear on them. Emphasis on the link between theoretical assertions and data. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Consent of the instructor.

401. **Theory and Method in Sociology. 4 hours.** Continues Sociology 400. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 400.

402. **Theory and Method in Sociology. 4 hours.** Continues Sociology 400 and 401. Required of all graduate majors. May be taken out of sequence with consent of the instructor. Prerequisite: Soc. 400 and 401.

403. **Advanced Statistics in Sociology. 4 hours.** Analysis of contingency tables; multiple and partial, linear and nonlinear correlation; analysis of variance. Prerequisite: Soc. 303.

404. **Survey Research Methods. 4 hours.** Same as Psychology 441. Methods of sampling human populations; interviewing techniques; techniques of analyzing survey data; uses and limits of sample surveys in testing hypotheses; supervised participation in survey research. Prerequisite: Soc. 403.

405. **Experimental Methods in Sociology. 4 hours.** Design and analysis of laboratory and field experiments on human groups and organizations; uses and limits of experiments in testing sociological hypotheses; supervised participation in experimental research. Prerequisite: Soc. 403.

411. **Small Groups; Structure and Process. 4 hours.** Same as Psychology 411. Systematic survey of research and theory dealing with social interaction and social relationships in small groups; primary groups as agents of social influence and social control. Prerequisite: Consent of the instructor.

415. **Social Diffusion Processes. 4 hours.** Processes by which information or specific practices diffuse through society; acceptance of innovation; opinion leadership and diffusion of opinion; research examples from adoption of farm practices and new medical treatments. Prerequisite: Consent of the instructor.

416. **Theories of Social Behavior. 4 hours.** Prerequisite: Psch. 315, 317, or 318.

418. **Theories of Personality. 4 hours.** Same as Psychology 472. Contemporary theoretical formulations concerning personality and their evidential basis. Prerequisite: Psch. 350 or 352.

441. **Social Organization. 4 hours.** Analysis of selected social institutions such as the family, educational system, political structure, and others; development and inter-relationship of social institutions; function of various institutions in simple and complex societies. Prerequisite: Consent of the instructor.

452. **Social and Cultural Factors in Health and Disease. 4 hours.** Same as Psychology 486. Methods of social epidemiology as applied to chronic and acute disease; psychosocial factors in illness; individual and social reactions to health and disease. Prerequisite: Soc. 351 or Psch. 380.

462. **The Family in Middle and Later Life. 4 hours.** Later phases of the life cycle pertaining to intergenerational relations; demographic trends; living arrangements and the kin network; husband and wife in later life; filial responsibility and the American family. Prerequisite: Soc. 345 or 361.

466. **Voting Behavior. 4 hours.** Principal sociological research procedures for collecting data on voting behavior; assessment of their relative contributions to understanding of who votes, how they vote, and why. Prerequisite: Soc. 365.

471. **Population Theory and Methods. 4 hours.** Critical examination of the nature and development of population theories; study of research techniques and application to problem areas. Prerequisite: Soc. 372.

476. **Sociology of Urban Life. 4 hours.** Demographic, ecological, and social processes involved in the development of the urban community; emphasis on the effects of urban development on these processes and the organization of human life in the city. Prerequisite: Soc. 376.

499. **Thesis Research. 0 to 16 hours.** May be repeated for credit. Students registering for thesis research will register for credit under this number.

Courses for Graduate and Advanced Undergraduate Students

303. **Sociological Statistics. 4 hours.** Introduction to statistical tests of sociological hypotheses; estimation procedures; selected statistical procedures commonly used in sociology. Prerequisite: Soc. 263.

315. **Advanced Social Psychology. 4 hours.** Same as Psychology 310. Critical analysis of empirical research on social perception, communication and influence, group structure, role analysis, and socialization processes. Individual projects are required. Prerequisites: Soc. 185 or Psch. 243, and 16 hours in sociology or psychology.

316. **Adult Socialization. 4 hours.** Socialization as a process of induction into new roles which occurs throughout the life cycle; the process is analyzed both at a social-psychological and a social-systems level with illustrations from various settings, such as marriage and family, illness, migration, and particularly socialization into occupations and professions. Prerequisite: 8 hours of sociology at the 200 or 300 level.

317. **Social Psychology of Theater. 4 hours.** Same as Speech 317. Compares social psychological theories which are explicitly dramaturgical and theories of drama which are explicitly social. Considers dramatic works as social psychological events. Prerequisite: Soc. 130 or Psch. 115.

320. **Sociology of Mass Communications. 4 hours.** Sociological analysis of the mass media of communication; empirical studies of the impact of the media on American society and culture; impact of television on children; effects of the media upon attitudes and opinions; processes by which news is created and transmitted. Prerequisite: 4 hours of upper-division sociology, or Soc. 100 and Spch. 113.

325. **Age Groups and the Social Order. 4 hours.** The relation of age groups to social structure; the demographic, sociological, and social-psychological conditions affecting the salience of age as a basis of social organization; recent writings on adolescents and youth; the theory of subcultures as applied to youth groups; relations between generations; current directions in the study of youth groups, both conventional and deviant. Prerequisite: 4 hours of upper-division sociology.

341. **Social Stratification and Classes. 4 hours.** Nature and systems of differentiation and ranking in societies, emphasis on the class structure in the United States; life chances, prestige, status, power, and social mobility in the United States and other societies. Prerequisite: Soc. 263.

343. **Sociology of Education. 4 hours.** The relationship of the educational system to the social structure, major emphasis on the role of education in an advanced technological society. Prerequisite: 8 hours of sociology.

344. **Industrial Sociology. 4 hours.** Analysis of industrial society and industrial institutions; the meaning of work and work relations and of the relationship between work and authority, with cross-cultural emphasis; sociological analysis of collective bargaining and of the impact of industrial and labor organizations on the community and on society. Prerequisite: 8 hours of sociology.

345. **The Sociology of the Family. 4 hours.** The family as a social institution; its origin, its

nature of kinship, its development, and its prospects. Prerequisite: 8 hours of sociology.

346. **Sociology of Science. 4 hours.** Organization of the scientific enterprise; emergence of science as a social institution; interrelations with other institutions such as government, religion, economy, and the arts. Science as a social phenomenon; regularities in scientific behavior; consideration of both historical and contemporary material. Prerequisite: 8 hours of sociology.

347. **Sociology of Complex Organizations. 4 hours.** Characteristics of business, government agencies, schools, hospitals, and other large-scale organizations, approaches used to study organizations, and theoretical and empirical analysis of organizational processes. Prerequisite: 8 hours of sociology.

348. **Military Institutions in American Society. 4 hours.** Analysis of military institutions as components of the larger society; recruitment and socialization processes, behavior patterns in military organizations, paramilitary groups, and patriotic societies. Prerequisite: 12 hours of sociology or political science.

349. **Sociology of Occupations and Professions. 4 hours.** Theoretical and empirical analysis of the occupational structure and occupational mobility processes in American and other industrial societies; patterns of recruitment and retention in occupations and professions. Prerequisite: Soc. 263.

351. **Medical Sociology. 4 hours.** Sociological contributions to medicine and public health; social organization and the organization of health services; the sociology of illness. Prerequisite: 8 hours of sociology.

361. **Social Gerontology: Old People in America. 4 hours.** The aged: demographic trends, economic status, physical and social needs, family relationships. Prerequisite: 8 hours of sociology.

365. **The Sociology of Politics. 4 hours.** Sociological interpretation of leadership, citizen participation, and the development of political organizations, using comparative materials from the United States and other countries. Prerequisite: 12 hours of sociology.

366. **Community Power Structure. 4 hours.** Analysis of the power structure of American communities; special emphasis on the relation between theoretical assumptions and research procedures in current community studies. Prerequisite: 12 hours of sociology.

371. **Population I. 4 hours.** Primarily for sociology majors and graduate students. The measurement and study of major trends and differentials in fertility, mortality, population growth, and age-sex composition in the United States and other countries. Emphasis on social and cultural determinants and consequences. Prerequisite: 12 hours of sociology, including Soc. 185 or the equivalent.

372. **Population II. 4 hours.** The measurement and study of major trends in migration, population composition, marriage and divorce in the United States and other countries; theories and policies regarding population growth in relation to resources; population forecasting. Prerequisite: Soc. 371.

373. **Human Ecology. 4 hours.** The relationship between man and the natural environment. Emphasis on importance of population patterns and human institutions in adaptation. Prerequisite: Soc. 271.

376. **Urban Sociology. 4 hours.** Review and analysis of recent research on urban areas, including their social organization, culture and subcultures, institutions, and contemporary problems. Prerequisites: Soc. 263 and 276.

385. **History of Sociological Theory. 4 hours.** The major theoretical systems that have developed in the field, beginning with the foundations in philosophical and scientific thought before Comte and proceeding to some of the contemporary representatives in the field. Prerequisite: Soc. 263 or 8 hours of sociology.

389. **Independent Study. 2 to 12 hours.** Supervised study projects for graduate students and honors undergraduates; may consist of extensive readings in specialized areas of sociology or empirical research; exclusive of credit given under Soc. 499. Prerequisites: Soc. 263, 20 hours of sociology, and approval of the department.

390. **Strategies of Research Design and Analysis. 4 hours.** The nature of sociological research; formulation of researchable problems; alternative research designs and procedures of data collection and analysis. Prerequisite: Soc. 263.

Additional Courses for Graduate Credit

ACCOUNTING

Courses for Graduate Students

400. **Managerial Accounting I. 4 hours.** Basic concepts and tools of analysis necessary for the quantification, recording, and communication of financial events.

401. **Managerial Accounting II. 4 hours.** Accounting methods applicable to the determination and analysis of financial data relevant to managerial decision problems. Topics include cost behavior, budgeting for planning and control, cost allocation, cost accounting systems, and capital budgeting. Prerequisite: Actg. 400.

402. **Financial Accounting I. 4 hours.** Formulation of a conceptual model of accounting valuation and its implications for accounting practice; accounting valuation methods applied to assets and equities, and their relationship to the conceptual model; concepts and criteria underlying income determination. Prerequisite: Actg. 401.

403. **Financial Accounting II. 4 hours.** Accounting procedures applicable to the formation, expansion, and dissolution of different business entities, such as partnerships, corporations, trusts, and estates; emphasis on accounting for the corporate entity. Prerequisite: Actg. 402.

406. **Financial Planning and Control. 4 hours.** The uses of financial information for

decisionmaking and control; the role of the accounting system and corporate controller in developing and refining the data necessary for cost control and managerial planning. Prerequisite: Actg. 401.

ADMINISTRATION OF CRIMINAL JUSTICE

Courses for Graduate and Advanced Undergraduate Students

350. **The Role of Law Enforcement in Community Relations. 4 hours.** Analysis of the relationship between law enforcement and the social structure of the community, including an examination of the significant problem areas involving minority elements, cultural and ethnic groups, power and social elite, and political and social-action movements. Prerequisites: CrJ. 101, 251, Soc. 225, 276, and PolS. 205.

351. **Criminal Law I: Substantive Criminal Law. 4 hours.** Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. General doctrines of criminal liability in the United States; classification of crimes as against persons, property, and the public welfare. Emphasis on the concept of governmental sanctions of the conduct of the individual. Prerequisites: CrJ. 101, 251, Soc. 225, and 276.

352. **Criminal Law II: Criminal Procedure. 4 hours.** Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. The criminal process. Legal problems associated with the investigation of crime, the acquisition of evidence, the commencement of a criminal proceeding, the prosecution and defense of charges, sentencing, and appeal. Principal concern is with the development of existing procedures and examination of current efforts for reform. Prerequisite: CrJ. 351.

353. **Criminal Law III: The Instrumentalities of Criminal Justice. 3 hours.** Continues Criminal Justice 352. Required in the curriculum in the administration of criminal justice; cannot be substituted for a criminal law course taken by law students. Examination of the agencies which play significant roles in the criminal process. Functions of the law enforcement agency, counsel, and the courts. Particular emphasis on the responsibilities and interrelationships of the agencies examined. Prerequisite: CrJ. 352.

354. **Evidence. 4 hours.** Rules of evidence as they apply to judicial proceedings and administrative hearings relative to the criminal process. Development of the underlying rationale of the rules. Emphasis on the relationship between methods of evidence collection and admissibility. Prerequisite: CrJ. 353.

360. **Industrial and Commercial Security Administration. 4 hours.** Theories and philosophy of the administration of industrial and commercial security functions; survey of contemporary organization and management of security operations; application of law enforcement principles within private enterprise. Prerequisites: CrJ. 257, 258, and 259.

391. **Proseminar in Criminal Justice. 4 hours.** Study in depth of current issues, problems, and developments of serious concern within the field of the administration of criminal justice. Prerequisites: CrJ. 101, 251, Soc. 225, 276, and PolS. 205.

399. **Independent Study. 4 hours.** For administration of criminal justice majors only. Independent study and research under the direct supervision of a faculty member, on a subject or subjects not covered in the regular curriculum. Prerequisites: Consent of the instructor by preregistration in the Curriculum Office, Soc. 225, 276, PolS. 205, and at least five criminal justice courses, including CrJ. 101 and 251.

ARCHITECTURE

Courses for Graduate and Advanced Undergraduate Students

301. **Architectural Design VII. 6 hours.** Comprehensive architectural problems. Prerequisite: Arch. 204.

302. **Architectural Design VIII. 6 hours.** Comprehensive architectural design problems. Prerequisite: Arch. 301.

309. **Architectural Design Thesis. 6, 9, or 12 hours.** May be repeated for a total of 18 hours. Individual problems in architectural design. Prerequisite: Arch. 301.

311. **Forensic Architecture. 3 hours.** Legal problems in architecture. Prerequisite: Fifth year standing.

313. **Building Construction Systems. 6 hours.** Static and dynamic environmental control systems. Prerequisites: Arch. 204 and 215.

314. **Industrialized Building. 3 hours.** Prefabrication of building components. Prerequisite: Fifth year standing.

315. **Logistics of Building Construction. 3 hours.** Problems encountered in the logistics of building construction. Prerequisite: Fifth year standing.

316. **Environmental Control Systems. 6 hours.** Problems of color, illumination, heating and air conditioning systems, and acoustics. Prerequisite: Arch. 313.

319. **Building Technology Thesis. 6, 9, or 12 hours.** May be repeated for a total of 18 quarter hours. Individual problems in building technology. Prerequisite: Arch. 313.

313. **Architecture Seminar. 3 hours.** May be repeated for a total of 9 hours. Current problems in architecture. Prerequisite: 9 hours in history of architecture.

332. **Reading Course. 3 hours.** May be repeated for a total of 9 hours. Individual study of significant writings on architecture.

334. **Chicago Buildings. 3 hours.** Architectural and technical history of Chicago's com-

mercial buildings from 1871 to the present. Prerequisite: 9 hours in history of architecture.

335. **Wright and His Contemporaries from 1890 to 1910. 3 hours.** A first-hand study of Wright's domestic buildings in the Chicago area and his relationship to other members of the Prairie School of midwest architecture. Prerequisite: 9 hours in history of architecture.

336. **Seminar: Adler and Sullivan. 3 hours.** A critical study of Chicago's foremost architectural partnership; their monuments, theories, and practice. Prerequisite: Arch. 334.

339. **Architectural Humanities Thesis. 12 hours.** Individual problems in the architectural humanities. Prerequisite: 21 hours in history of architecture.

343. **Professional Practice. 3 hours.** Problems related to the practice of architecture. Prerequisite: Fifth year standing.

ECONOMICS

Courses for Graduate Students

400. **Managerial Economics. 4 hours.** Economic analysis applied to business operations; theory of production and cost analysis; capital theory; pricing of products and factors. Prerequisites: Econ. 320, 321, and Fin. 341.

Courses for Graduate and Advanced Undergraduate Students

320. **Macroeconomic Theory. 4 hours.** Principles of national income accounting, determination of aggregate income and employment, the monetary system in relation to income and employment, short-term income fluctuations, long-term income growth. Prerequisite: Fin. 340 or Phase II MBA student standing.

321. **Microeconomic Theory. 4 hours.** Operation of individual markets; market structure; theory of the firm; theory of production; demand theory; general equilibrium and welfare economics. Prerequisite: Fin. 340 or Phase I MBA student standing.

FRENCH

Courses for Graduate and Advanced Undergraduate Students

313. **Stylistics I: Prose. 4 hours.** Detailed analysis of the style of selected French authors; practice in advanced composition. Prerequisite: Fr. 211.

314. **Stylistics II: Poetry. 4 hours.** Detailed analysis of the style of selected French authors; practice in advanced composition. Prerequisite: Fr. 211.

317. **Modern French Drama I. 4 hours.** Major dramatists of the nineteenth and twentieth centuries. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

318. **Modern French Drama II. 4 hours.** Continues French 317. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

319. **Modern French Drama III. 4 hours.** Continues French 317 and 318. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

321. **French Literature of the Middle Ages. 4 hours.** Major works, to be read in modern French. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

322. **French Literature of the Sixteenth Century. 4 hours.** Major writers, to be read in modern French. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

323. **French Classical Literature I. 4 hours.** Major nondramatic writers of the seventeenth century. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

324. **French Classical Literature II. 4 hours.** Major dramatists of the seventeenth century. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

325. **French Literature of the Eighteenth Century I. 4 hours.** Major nondramatic writers. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

326. **French Literature of the Eighteenth Century II. 4 hours.** Major dramatists. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

327. **French Poetry I. 4 hours.** Major poets from the fourteenth through the eighteenth centuries. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

328. **French Poetry II. 4 hours.** Major poets of the nineteenth and twentieth centuries. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

329. **French Poetry III. 4 hours.** Major poets of the twentieth century. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

331. **The French Novel of the Nineteenth Century I. 4 hours.** Major novelists. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

332. **The French Novel of the Nineteenth Century II. 4 hours.** Major novelists. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

333. **The French Novel of the Nineteenth Century III. 4 hours.** Major novelists. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

337. **The French Novel of the Twentieth Century I. 4 hours.** Reading and analysis of selected novels from 1900 to 1940. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

338. **The French Novel of the Twentieth Century II. 4 hours.** Reading and analysis of

selected novels from 1940 to the present. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

342.   **The *Pleiade*.** 4 hours. Theory and practices of the *Pleiade* poets. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

345.   **Montaigne: His *Essais* and His Age.** 4 hours. Detailed study of Montaigne's life, thought, and times as reflected in the *Essais*. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

350.   **Preromanticism.** 4 hours. The Preromantic movement in France from 1761 to 1814. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

351.   **French Romanticism I.** 4 hours. Reading and analysis of selected works tracing the main developments in the Romantic movement from 1815 to 1829. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

352.   **French Romanticism II.** 4 hours. Reading and analysis of selected works tracing the main developments in the Romantic movement from 1830 to 1850. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

355.   **Literary and Intellectual Currents of the Eighteenth Century.** 4 hours. Reading and analysis of selected works tracing the major literary and intellectual currents. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

360.   **Major Trends in French Literature.** 4 hours. Selected writings to illustrate major trends instrumental in the formation of critical and aesthetic principles of French literature. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

362.   **The French Novel from 1600 to 1715.** 4 hours. Reading and analysis of selected novels of the period. Prerequisites: Fr. 201, 202, and 203.

363.   **The French Novel from 1715 to 1789.** 4 hours. Reading and analysis of selected novels of the period. Prerequisites: Fr. 201, 202, and 203 or the equivalents.

GEOGRAPHY

Courses for Graduate and Advanced Undergraduate Students

301.   **Fundamentals of Landform Analysis.** 3 hours. Theories of landform processes and techniques of analysis. Prerequisite: Geog. 101 or GeolS. 102.

326.   **Geography of Middle America.** 4 hours. Physical landscapes and the human responses (cultural, economic, and political) to them in Mexico, Central America, and the West Indies. Prerequisite: 10 hours of geography.

334.   **Southern and Southeastern Asia.** 4 hours. Physical and cultural landscapes; physical

regions, people, mineral wealth, agricultural production, manufacturing, trade, political alignments. Prerequisite: 10 hours of geography.

342. **Geographic Information Systems II. 3 hours.** Application of inferential statistical techniques and probability models in geographic research. Topics include: use of descriptive parameters in recognizing geographic relationships, tests of significance, and recognition of particular areal patterns. Prerequisite: Geog. 341.

343. **Geographic Information Systems III. 3 hours.** Problems encountered in the management and portrayal of geographic data. Topics include: preparation of data for manual and machine processing, data condensation and characterization, observation indexing, and the preparation of graphic and tabular displays. Prerequisite: Geog. 342.

399. **Special Studies in Geography. 2 to 5 hours.** May be repeated twice for credit for a total of 10 hours. Readings and reports in selected fields chosen in consultation with the instructor. Prerequisite: Consent of the instructor.

HISTORY OF ARCHITECTURE AND ART

Courses for Graduate and Advanced Undergraduate Students

341. **Art of the Fifteenth Century in Florence. 4 hours.** Stylistic and iconographic studies of the works of the major painters, sculptors, and architects. Florentine history and literature in their relation to the visual arts. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.

342. **Art of the High Renaissance. 4 hours.** Art of the great Italian centers during the late fifteenth and early sixteenth centuries. Emphasis on Leonardo, Raphael, Bramante, Bellini, Giorgione, and Michelangelo. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.

361. **Proseminar in Modern Painting. 4 hours.** May be repeated for credit at the discretion of the department. Selected examples; development and diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisite: 4 hours in history of architecture and art at the 200 level.

362. **Proseminar in Modern Sculpture. 4 hours.** May be repeated for credit at the discretion of the department. Selected examples; development and diffusion of style and iconography. Analogies in the history of ideas and events, technical change, and other pertinent material. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.

363. **Contemporary Art. 4 hours.** The most recent developments in contemporary art, its theories and production. Prerequisite: 4 hours in history of architecture and art courses at the 200 level.

391.   **Special Studies in History of Art. 4 hours.** May be repeated for a total of 12 hours. Discussions of special problems with attention to a major theme, period, or artist each quarter. Student reports required. Prerequisite: 12 hours in history of architecture and art courses at the 200 and 300 levels.

392.   **Readings in Art History. 4 hours.** May be repeated for credit at the discretion of the department. Individually planned readings on selected topics under the supervision of a faculty member. Prior to registration the student should be advised by the instructor. Prerequisite: 12 hours in history of architecture and art courses at the 200 and 300 levels.

LATIN

Courses for Graduate and Advanced Undergraduate Students

302.   **Vergil I: *Aeneid*. 4 hours.** First course in a three-course sequence covering the major works of Vergil. Prerequisite: Consent of the instructor.

303.   **Vergil II: *Aeneid*. 4 hours.** Continues Latin 302. Prerequisite: Lat. 302.

304.   **Vergil III: *Aeneid*. 4 hours.** Continues Latin 303. Prerequisite: Lat. 303.

350.   **Medieval Latin. 4 hours.** A literary and linguistic study of Latin texts originating between 350 and 1350 A.D. Prerequisites: Lat. 106 and 203 or the equivalents.

360.   **Horace: *Odes and Epodes*. 4 hours.** The chief lyrical poems. Prerequisite: A 200-level course in Latin.

361.   **Horace: *Saturae*. 4 hours.** The satirical poems. Prerequisites: Lat. 106 and 203 or the equivalents.

370.   **Tacitus: *Selections*. 4 hours.** Selections from the historical and biographical works. Prerequisite: A 200-level course in Latin.

MANAGEMENT

Courses for Graduate Students

451.   **Organization Theory. 4 hours.** Classical and modern theories of organization. Organization structure and processes, line and staff relationships, managment controls, managerial decisionmaking, organizational objectives and restraints, management functions, formal and informal organization, bureaucracy, and behavioral science concepts. Prerequisite: Mgmt. 350.

452.   **Administrative Practices. 4 hours.** Analysis of human problems in management and organization. Dynamics of leadership in the working organization, group dynamics, administrative behavioral patterns, administrative implications of decisionmaking and policy formulation, and other relevant behavioral science concepts. Prerequisite: Mgmt. 451.

453.   **Personnel Management. 4 hours.** Manpower management programs and policies. Staffing, training and development, historical evolution of personnel policies, modern labor force and technological trends, supervision, wage and salary administration, and manpower research and utilization. Prerequisites: Mgmt. 350 or the equivalent, and 451.

455.   **Operations and Systems Management. 4 hours.** Basic principles and procedures for effective utilization of productive factors in a working organization. Facilities design, control systems, data processing, scheduling, automation, statistical analysis, computer technology, production planning, process design, and other relevant management science concepts.

457.   **Seminar in International Business. 4 hours.** Management practices and problems in major nations. Legal and cultural factors affecting managerial policies and decisions; organization planning and manpower utilization, comparative management systems and ideologies. Prerequisite: Mgmt. 451.

458.   **Seminar in Business Policy and Decision Theory. 4 hours.** To be taken in final quarter of the student's degree program. A capstone course to integrate all the functional areas of business: policy formulation and administration, policy and decision implementation, long-range planning, control techniques, factor analysis and decisionmaking, theories of decisionmaking in an uncertain environment, quantitative techniques, simulation and case exercises, and study of actual business forms.

Courses for Graduate and Advanced Undergraduate Students

399.   **Independent Study. 2 to 4 hours.** May be repeated once for credit. Students in the College of Business Administration may register for this course to pursue advanced independent study in approved topic(s) related to management. Written report prepared under the guidance of a major professor is required. Prerequisites: Consent of the department head and 16 hours of management courses at the 200 and 300 level.

MUSIC

Courses for Graduate and Advanced Undergraduate Students

300.   **Sixteenth Century Counterpoint. 3 hours.** Late Renaissance music. Analysis of representative scores and written assignments in sixteenth century contrapuntal style. Prerequisites: Mus. 203 and 206 or approval of the department.

301. **Eighteenth Century Counterpoint. 3 hours.** Middle-to-late Baroque music. Analysis of representative scores and written assignments in eighteenth century contrapuntal style. Prerequisite: Mus. 300 or approval of the department.

302. **Form and Analysis. 3 hours.** The melodic, rhythmic, harmonic, and structural analytic procedures of traditional musical form. Analysis of representative scores from the eighteenth to the twentieth centuries. Prerequisite: Mus. 301.

303. **Compositional Techniques of the Twentieth Century. 4 hours.** European and American twentieth century music. Analysis of representative scores and written assignments in composition in one or more of the several contemporary idioms. Prerequisite: Mus. 302.

QUANTITATIVE METHODS

Courses for Graduate Students

470. **Mathematical Methods I. 4 hours.** Designed primarily to introduce and/or review areas of mathematics necessary for the development and understanding of the analytic tools students will encounter in subsequent courses of the Master in business administration program. Elementary set theory; mathematical functions; introduction to probability concepts; differential and integral calculus; series; functions of several variables. Prerequisites: Math. 110, 111, 112; QM 170, 171, and 172.

471. **Mathematical Methods II. 4 hours.** Sets and set functions; vector and matrix algebra; introduction to linear programming and game theory. At least one hour per week of laboratory in the use and application of digital computers and development in computer technology applicable to modern business operations. Prerequisites: Math. 110, 111, 112; QM 170, 171, and 172.

472. **Statistics, Theory, and Applications. 4 hours.** Statistics and scientific method; uncertainty and probability, including Bayesian theory; binomial normal, t, Chi square, and F distributions; testing hypotheses and estimation; decision theory; analysis of variance, including regression and correlation; times series. Prerequisites: Math. 110, 111, 112; QM 170, 171, and 172.

473. **Analysis of Variance and Experimental Design. 4 hours.** General theory of design and analysis of experiments. Least squares estimation, multiple regression, analysis of variance, randomization, randomized blocks, Latin squares, factorial designs, replication, incomplete blocks. Prerequisite: QM 472.

474. **Statistical Decision Theory. 4 hours.** Hypothesis testing from the classical and Bayesian viewpoints with applications of probability to the making of decisions; some treatment of game strategy and its parallels in decisionmaking. Prerequisite: QM 472.

475. **Business Research and Forecasting. 4 hours.** The role of research in business,

forecasting methods and techniques, including models and their applications. Prerequisite: QM 472.

Courses for Graduate and Advanced Undergraduate Students

376. **Survey of Operations Research. 4 hours.** Methods, techniques, and applications; linear programming, simulation, production and inventory theory, queuing theory, game theory. Prerequisites: QM 172 and Math. 112.

378. **Dynamic Programming. 4 hours.** Theory and application to solving problems in multistage decision processes arising in a wide variety of fields such as operations research, engineering, and mathematics. Deterministic and random processes are considered, and computational and analytical methods of solution derived. Prerequisite: Math. 133 and 220 or the equivalents; QM 375 and 376.

SLAVIC LANGUAGES AND LITERATURES

Courses for Graduate and Advanced Undergraduate Students

350. **Russian Novel I. 4 hours.** Historical and critical study of the development of the Russian novel from 1800 to about 1860: Pushkin, Lermontov, Gogol, Goncharov, Aksakov, Chernishevsky. Prerequisite: Consent of the instructor.

351. **Russian Novel II. 4 hours.** Continues Slavic 350. The development of the Russian novel from 1860 to about 1900: Turgenev, Alexey Tolstoy, Saltykov-Shchedrin, Lev Tolstoy, Dostoevsky, Leskov. Prerequisite: Consent of the instructor.

360. **Survey of Russian Drama. 4 hours.** Major authors from the beginning of the Enlightenment to the end of the nineteenth century: Sumarokov, Fonvizin, Ozerov, Griboyedov, Pushkin, Gogol, Turgenev, Ostrovsky, A. Tolstoy, L. Tolstoy, Chekhov, Gorky. Prerequisite: Slav. 224 or Spch. 122.

SPANISH

Courses for Graduate and Advanced Undergraduate Students

306. **Romanticism and Realism in Nineteenth Century Spanish Literature. 4 hours.** Continues Spanish 305. Prerequisite: Span. 305.

307. **The Generation of 1898. 4 hours.** Representative works of Baroja, Azorin, Unamuno, Maeztu, Valle Inclan, Benavente, A. Machado, and others. Prerequisites: Span. 218 and 219, or 221 and 222.

310. **Modernismo and Contemporary Spanish-American Poetry. 4 hours.** From 1888 to the present; some Modernista prose. Prerequisites: Span. 223 and 224 or the equivalents.

320. **The Contemporary Spanish Novel. 4 hours.** Development since 1936. Prerequisites: Span. 218 and 219, 221 and 222, or the equivalents.

321. **The Contemporary Spanish Novel. 4 hours.** Continues Spanish 320. Prerequisite: Span. 320.

342. **Introduction to Romance Philology. 3 hours.** History of the Romance languages, especially Spanish, French, Italian, and Portuguese, from the classical Latin period to the present, including their external history, phonology, morphology, and syntax. Prerequisites: Span. 218 and 2 years of college-level French.

349. **Phonetics. 4 hours.** Prerequisites: Span. 213, and 218 or 221.

SPEECH AND THEATRE

Courses for Graduate and Advanced Undergraduate Students

317. **Social Psychology of Theater. 4 hours.** Same as Sociology 317. Compares social psychological theories which are explicitly dramaturgical and theories of drama which are explicitly social. Considers dramatic works as social psychological events. Prerequisite: Soc. 130 or Psch. 115.

331. **Mass Media Programming. 4 hours.** Mass media program types, objectives, methods, and effects; creative development of programs from conception to script. Prerequisites: Spch. 232 and one other course in speech.

333. **Mass Communications Seminar. 4 hours.** The nature of mass media in contemporary society. The legal and social responsibilities of mass media institutions in the United States and abroad. Prerequisites: Spch. 231 and one other course in speech.

351. **Scene Design and Lighting. 4 hours.** A lecture-laboratory approach to the role of stage lighting in scene design. Analysis of historical background and sources; special emphasis on areas such as theories, psychological and aesthetic factors, and lighting application techniques, and equipment. Lectures, readings, and practical problems. Prerequisite: Spch. 251.

361. **Periods and Styles of Acting. 4 hours.** Concentration on premodern styles of acting from these periods: classic Greece, *commedia dell'arte,* Elizabethan, Restoration and the eighteenth century, nineteenth century melodrama, and naturalism. Prerequisite: Spch. 262.

371. **Advanced Study in Language. No credit.** Intensive study of language and speech activities of elementary school children; particular attention to those children labeled language disabilitied. Includes the study of language acquisition and applicable speech activities.

SYSTEMS ENGINEERING

Courses for Graduate and Advanced Undergraduate Students

330.   **Transportation Systems Analysis II. 3 hours.** Continues studies of transportation as a process and a system; detailed analyses of relation between major engineering systems providing transportation and economic, social, political, and psychological aspects of human activities; studies of financial and institutional factors affecting transport investments; integration of subsystem models for comprehensive analytical studies. Prerequisites: SysE. 230 and credit or registration in Econ. 120.

331.   **Transportation Systems Engineering. 3 hours.** Examination of fundamental physical relationships governing the operation and design of transportation systems and their components; general and specific analyses of system performance characteristics as a function of component specifications and system design. Prerequisites: SysE. 330, Phys. 111, and MatE. 102, or consent of the instructor.

332.   **Transportation Systems Planning. 3 hours.** Philosophies, strategies, and specific analytical techniques for planning large transportation systems; analysis and critique of contemporary institutional structures and models used for transportation planning; general and specific methods of forecasting future needs, developing plans, and evaluating alternatives; application of various techniques to practical transportation planning problems. Prerequisites: SysE. 330 and credit or registration in SysE. 371.

355.   **Urban Systems Analysis II. 3 hours.** Introduction to the analysis of dynamic urban systems; urban process analysis; and modeling of growth and development processes; studies of decentralized and centralized decisional systems; quantitative analysis techniques for modeling; evaluating the performance of existing and planned urban and regional systems and components; analysis and evaluation of technologically based regional policies. Prerequisites: SysE. 240 and credit or registration in Econ. 120.

356.   **Urban Systems Planning. 3 hours.** Introduction to philosophies, theories, strategies, and techniques of urban systems planning; studies of urban value systems and the development of operational planning objectives; planning information systems, data collection and analysis; predictive model development; plan design methods; analysis of resources allocation; plan testing and evaluation; application of specific techniques to laboratory problems. Prerequisites: SysE. 230 and 355; credit or registration in SysE. 371 and Econ. 121.

360.   **Traffic Flow and Control Systems. 3 hours.** Introduction to particulate flow systems; investigation of microscopic flow relations and their effect on macroscopic flow properties; generalized study of traffic control systems; integrated investigation of flow properties, control systems, and system safety characteristics; applications to highway and air traffic flow. Laboratory work in data collection, analysis, and simulation studies. Prerequisites: SysE. 331, Math. 195, 370, and credit or registration in SysE. 350.

361.   **Transportation Systems Evaluation. 2 hours.** Strategies and techniques of trans-

portation systems evaluation; discussion of public works investment-decision processes and the role of the engineer; economic, social, psychological, and political analysis of transportation plans; market studies and simulation techniques; cost-effectiveness studies and program budgeting systems. Prerequisites: SysE. 332 and 360, and credit or registration in Econ. 121.

371. **Optimization Techniques I. 4 hours.** Linear programming models, Simplex method, sensitivity analysis, transportation problem, duality. Nonlinear programming models, separable objective function, geometric programming, Kuhn-Tucker equations, quadratic programming. Prerequisites: Math. 195 and 220.

372. **Optimization Techniques II. 4 hours.** Dynamic programming. Optimal control theory: Bellman, Hamilton-Jacobi, and Euler; Lagrange equations; Pontryagin's maximum principle. Search techniques, golden mean and Fibonacci search, gradient approach, stochastic approximation. Prerequisite: SysE. 371.

380. **Quantitative Methods in Urban Engineering. 3 hours.** Theory and application of fundamental statistical and mathematical techniques of measurement and data analysis for urban systems engineering; presentation and critical review of selected quantitative methods appropriate to identifying problems, establishing design standards, and evaluating the performance of urban engineering systems. Prerequisites: SysE. 356, Math. 195, and 370.

381. **Projects in Urban Systems Engineering. 2 hours.** Analytical and experimental projects in urban systems engineering and planning. Prerequisites: SysE. 380 and credit or registration in SysE. 350.

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AMON, RENE, Ph.D., Associate Professor, Architecture
ANDERSON, AEMER D., Ph.D., Assistant Professor, Energy Engineering
ANDERSON, CLAIRE M., Ph.D., Assistant Professor, Social Work
ANDERSON, LOUISE E., Ph.D., Assistant Professor, Biological Sciences
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TYLER, THOMAS A., Ph.D., Assistant Professor, Psychology

UHERKA, KENNETH L., Ph.D., Assistant Professor, Energy Engineering
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VALES, ROBERT L., Ph.D., Assistant Professor, English
VANDERKOOI, RONALD C., Ph.D., Assistant Professor, Sociology
VANVALEN, PHEBE, Ph.D., Assistant Professor, Biological Sciences
VARDAMAN, HAZEL C., Ph.D., Professor, German
VEZZETTI, DAVID J., Ph.D., Associate Professor, Physics
VISWANATHAN, NARAYAN, D.S.W., Associate Professor, Social Work

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WEINER, SYLVAN R., Ph.D., Associate Professor, English
WEINZWEIG, AVRUM I., Ph.D., Associate Professor, Mathematics
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WHITMER, ROGER G., M.S., Assistant Professor, Architecture
WIDERA, OTTO E., Ph.D., Associate Professor, Materials Engineering
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WILEY, MARY G., Ph.D., Assistant Professor, Sociology
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WILLETT, MAURITA, Ph.D., Associate Professor, English
WILLEY, ROBERT B., Ph.D., Associate Professor, Biological Sciences
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WINE, MARTIN L., Ph.D., Professor, English
WINSBERG, LESTER, Ph.D., Professor, Physics
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WOLF, JOHN B., Ph.D., Professor, History
WOOD, BARBARA S., Ph.D., Assistant Professor, Speech and Theatre
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YUSEM, MILTON, Ph.D., Assistant Professor, Chemistry

ZABRODSKY, ALEXANDER, Ph.D., Assistant Professor, Mathematics
ZAHROBSKY, ROBERT E., Ph.D., Assistant Professor, Chemistry
ZIFF, PAUL, Ph.D., Professor, Philosophy
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ZUBER, BERT L., Ph.D., Associate Professor, Information Engineering

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